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PROCESS MANUFACTURING OPPORTUNITIES

EUROPEAN SOFTWARE AND SERVICES

1991-1996

INPUT®

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Market Analysis Programme—Europe

***Process Manufacturing Opportunities—
European Software and Services, 1991-1996***

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Abstract

This report analyses the market for software and services in the Western European process manufacturing sector. It identifies the major issues and opportunities for vendors together with the driving forces influencing the use of software and services in the process manufacturing sector. Market forecasts are provided both for the major country markets—Germany, France, the United Kingdom and Italy—and by key delivery mode. The principal delivery modes are turnkey systems, industry-specific application software products, professional services, systems integration, network services, systems operations and processing services. The leading vendors within each country market are identified.

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I

Introduction

A

Objectives

The principal objectives of this report are:

- To forecast the size of the market for software and services in the process manufacturing sector for Western Europe and for each of the major country markets over the period 1991-1996.
- To forecast the size of the market for software and services in the process manufacturing sector by delivery mode.
- To identify the leading software and services vendors to the process manufacturing sector in each of the major country markets.
- To identify the major issues facing software and services vendors targeting the process manufacturing sector.
- To identify the driving forces influencing the demand for software and services within the process manufacturing sector.
- To identify the changing role of logistics in the process manufacturing sector.
- To identify the opportunities arising for software and services vendors in this sector over the period 1991-1996.

B

Scope

This report analyses the market for software and services within the Western European process manufacturing sector over the period 1991-1996.

The process manufacturing sector is defined as:

- Food, drink and tobacco industry
- Timber industry
- Manufacturing of paper and paper products
- Chemical industry
- Man-made fibres industry
- Processing of rubber and plastics
- Extraction of petroleum and natural gas
- Mineral oil refining
- Extraction and briqueting of solid fuels
- Extraction and processing of other non-energy producing minerals

Geographically the report divides Western Europe into:

- Germany
- France
- United Kingdom
- Italy
- Rest of Europe

Market forecasts are derived from corporate user expenditures on software and services. Forecasts are provided over the period 1991-1996 for each of the key delivery modes, namely:

- Industry-specific application software products
- Turnkey systems
- Professional services
- Systems integration
- Network services
- Systems operations
- Processing services

C

Methodology

The research that contributed to this study was derived from the following sources:

- Twenty-five in-depth interviews conducted either face-to-face or by telephone with leading vendors and users active in the Western European process manufacturing sector, together with ten interviews of users and vendors focussing on logistics software and services.

- INPUT's ongoing research of the Western European software and services market, which includes the collection of revenue and service product data from over 300 vendors annually.

- The use of INPUT's extensive library facilities, which include vendor literature and press releases, as well as trade press, newspaper and magazine articles.

D

Report Structure

Chapter I provides details of the objectives and scope of the research.

Chapter II is the Executive Overview of the entire report. It summarises the principal findings of the research with an emphasis on the opportunities for software and services vendors in the process manufacturing sector.

Chapter III contains market forecasts at the Western European level and considers the overall prospects for the major subsectors of the process manufacturing sector.

Chapter IV contains market forecasts for France, Germany, the United Kingdom and Italy and lists the leading vendors in each country.

Chapter V analyses the software and services market by delivery mode across the process manufacturing sector. For each delivery mode, a market forecast is provided and the major trends identified.

Chapter VI identifies the major issues facing software and services vendors in the process manufacturing sector and the generic strategies being followed by the main types of vendor.

Chapter VII discusses the driving forces within the process manufacturing sector and the issues facing users in this sector.

Chapter VIII looks at the changing role of logistics within the process manufacturing sector.

Chapter IX lists the major opportunities within the process manufacturing sector for software and services vendors, and summarises some of the major issues facing vendors.

II

Executive Overview

A

Supply Chain Management—A Critical Success Factor in the Food and Drink Sector

As manufacturers gain better control over the production environment through use of production management and production supervision and control software, they are turning their attention to distribution systems in search of additional efficiency and responsiveness to customer demand.

The food and drink sector, in particular, is turning its attention to logistics, driven by the pressure for "just-in-time" deliveries from the major retail multiples.

The major requirements of these manufacturers are for:

- Better long-term planning and sales forecasts
- Warehouse management/automation systems
- Better integration of existing applications

Better forecasting of demand is critical since this has a major impact on the stockholding costs of finished goods.

A number of software products are now available which assist planning across multiple manufacturing and distribution sites. Some use knowledge-based software to take into account local factors influencing demand.

There are also opportunities for suppliers of warehouse management systems, as automated warehousing is being adopted for distribution centre-to-distribution centre operations. To improve warehouse operative efficiency, many systems now incorporate the radio transmission of picking lists to hand-held units. Other systems enable multiple orders to be picked simultaneously to reduce operative movement around the warehouse and increase efficiency.

In the past, many information systems supporting logistics operations have existed as "islands of automation", such as:

- Forecasting & planning
- Warehousing
- Transport management
- Customer service management

There is now a need to integrate these and to measure the performance of the logistics operation as a whole.

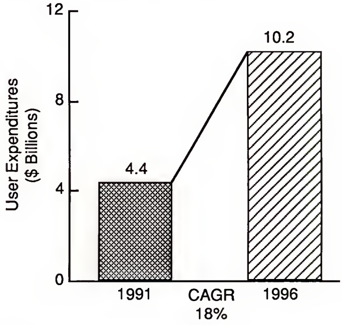
B

Key Industries and Market Forecasts

INPUT forecasts that the market for industry-specific software and services within the Western European process manufacturing sector will grow strongly over the next five years, as shown in Exhibit II-1.

EXHIBIT II-1

Software and Services Market Forecast, 1991-1996
Process Manufacturing Sector, Western Europe



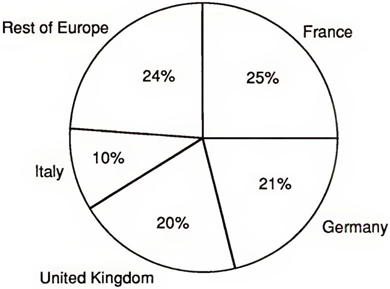
This comparatively high level of growth in the present economic climate is initially being fuelled by the take-up of production management systems, and will be subsequently maintained by the integration of these systems with systems for supervisory control and data acquisition (SCADA) linked to the process plant.

While the growth rate for the whole of the software and services market obviously shows some variation from country to country and amongst delivery modes, these differences are less marked than those in the discrete manufacturing sector. The country differences are less dramatic because the principal sectors such as food and pharmaceuticals are to some extent recession-proof, while the impact of the present high oil price has had a fairly comparable effect on the petrochemicals sector in each of the major countries.

Exhibit II-2 shows the market for software and services within the process manufacturing sector in Western Europe broken down by country.

EXHIBIT II-2

Software and Services Market
Percentage Distribution by Country, 1991
Process Manufacturing Sector, Western Europe



Total market (1991) = $4.4 billion

At the present time, the largest single national market is France with a market value of $1,080 million, followed by Germany and the United Kingdom. While Germany is expected eventually to become the most important national market in this sector, similar growth rates are forecast for the major national markets over the next five years, with Germany—growing at 20% per annum—only slightly ahead of France and the United Kingdom which will grow at a compound annual growth rate of 18% per annum. The Italian market is forecast to grow at the slower rate of 16% per annum.

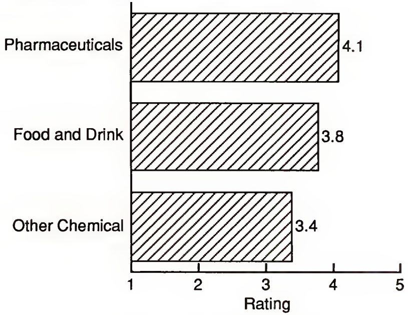
Growth in software and services within the process manufacturing sector in the United Kingdom is not expected to fall to the levels seen in the discrete manufacturing sector since, despite cutbacks in capital expenditure by companies such as ICI, the food and pharmaceuticals sectors are expected to show some resilience to recession. Only the petrochemicals sector is highly susceptible to the present economic situation and this applies equally to companies in Germany, France and Italy, many of whom are very dependent on basic, rather than speciality chemicals. For example, BASF has recently announced reduced profit forecasts and a number of plant closures.

Overall, as shown in Exhibit II-3, software and services vendors believe the most promising industries for their services in Western Europe to be pharmaceuticals and food and beverages. However there were noticeable differences in attitude to the food and drink sector amongst vendor categories. The food and drink sector was highly rated by the equipment vendors and by the application software product vendors. However it was perceived to be only a moderately promising sector by the professional services vendors, who in some cases were finding the food and drink sector fragmented and difficult to penetrate.

Overall the Western European process manufacturing sector is perceived as offering considerable opportunities to software and services vendors over the next few years.

EXHIBIT II-3

Industries—Growth Prospects
Process Manufacturing Sector, Western Europe



Scale 1-5: 1 = Poor, 5 = Excellent
Sample of 15 software and services vendors.
Standard error = 0.2

C

Application Software Products and Turnkey Systems

At present, as shown in Exhibit II-4, there is strong growth in the application software product and turnkey systems markets fuelled by users' increasing acceptance of industry-specific application packages. While the application showing highest levels of demand is production management, other important application areas include:

- Supervisory control and data acquisition (SCADA)
- Production Supervision and Control
- Integrated quality management systems (including in-line quality testing)

Maintenance management is another important application in the process manufacturing sector but it is already well-established there, and is not considered to be a major area of opportunity for vendors.

EXHIBIT II-4

Market Forecasts, 1991-1996 Applications Software Products and Turnkey Systems Process Manufacturing Sector, Western Europe

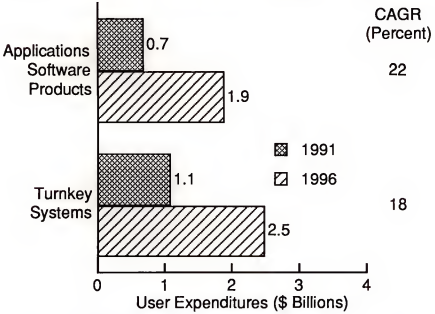


Exhibit II-5 shows users' and vendors' perceptions of these key trends. Until recently production management systems in the process manufacturing sector were typically developed in-house by users. This now seems to be largely a thing of the past. Even so, in some countries there may still be a small time lag before this trend becomes established and users recognise the suitability of the packages now being developed for their industry.

EXHIBIT II-5

Software Product Trends Process Manufacturing Sector, Western Europe

Trend	Users' Perception	Vendors' Perception
Increasing Reliance On Packages	Very High	High
Increasing Demand For Production Management Systems	Very High	High

This change in the market has been recognised by the equipment vendors and the traditional production management software product vendors. During 1990 many of these vendors, for example ASK, announced products for the process manufacturing sector, and many more vendors are likely to enter the market in 1991. This is leading to high levels of competition.

On the other hand, the noticeable gap between the perceptions of users and vendors in estimating the extent of the increased demand for production management systems is largely caused by the stance taken by a number of professional services vendors, who do not seem to be well positioned to offer software products to this sector.

The embryonic nature of the market overall is illustrated by the figures recently released by ASK in 1990, stating that of the company's 3,200 customers worldwide, there were only 100 process manufacturing companies using ASK software and Digital hardware.

At present, many of the production management systems being installed are centralised systems, but over the next few years there will be an increasing trend to distributed systems as the technology becomes both available and proven.

There is also an increasing demand for UNIX as the platform for systems in general and production management systems in particular. The level of acceptance of UNIX shown in Exhibit II-6 is much higher in the process manufacturing sector than in the discrete manufacturing sector, particularly among large organisations, and the market growth of UNIX-based systems is likely to be significantly higher in the process manufacturing sector over the next few years. Proprietary architectures are much more entrenched in the discrete manufacturing sector, and attitudes to UNIX are more conservative. In the process manufacturing sector, UNIX is frequently seen as the key to achieving computer-integrated processing and compatibility between application software products.

EXHIBIT II-6

Software Product Trends: Increasing Demand for UNIX at Production Management Level Process Manufacturing Sector, Western Europe

Sample Group	Degree of Agreement That Demand Is Increasing
Users	Medium
Vendors	Medium

Another difference between the two sectors is the difference in attitude towards UNIX at the shopfloor and production administration levels. In the discrete manufacturing sector, UNIX is expected to initially gain a foothold at the shopfloor level and only slowly move up to the production administration level. However in the process manufacturing sector, UNIX is expected to make a significant impact initially at the production administration level.

D

Systems Integration and Professional Services

Users in the process manufacturing sector are increasingly using external vendors for consultancy and for integrating the various application areas.

Both users and vendors report:

- An increase in usage of external software development staff
- Corresponding increase on external spending for software and services
- Some reduction in user staff levels

However, in many instances, the initial priority is to implement production management systems, and so this will delay the commencement of any integration work for several years. The resulting overall growth in these delivery modes is shown in Exhibit II-7.

EXHIBIT II-7

Market Forecasts, 1991-1996
Systems Integration and Professional Services
Process Manufacturing Sector, Western Europe

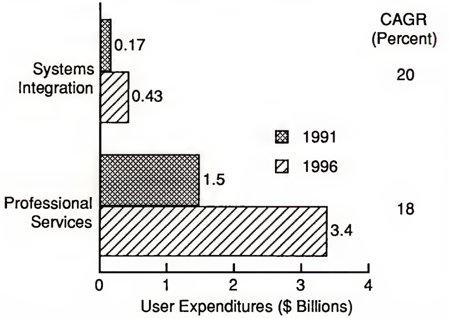


Exhibit II-8 shows that users in the process manufacturing sector have firm intentions both of integrating their production management systems with the process control equipment via supervisory control and data acquisition (SCADA) systems and of moving towards a computer-integrated processing environment.

EXHIBIT II-8

Planned Levels of Integration
Process Manufacturing Sector, Western Europe

Integration Of Production Management and SCADA Systems	High
Full Computer-Integrated Manufacturing	High

Although some companies are planning to integrate these components of their systems in the short term, process manufacturing companies are typically expecting to link their production management and process control systems in two to five years. Integration will prove of major benefit to users in improving their responsiveness to their customers by providing them with up-to-date information on production achievements. It will also greatly assist them both in achieving high levels of quality and in demonstrating their control of consistent quality levels.

Overall the major equipment vendors have been more pro-active than many of the professional services vendors in establishing their ability to offer systems integration to users in the process manufacturing sector.

E

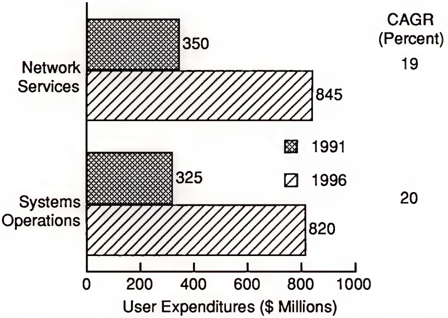
Network Services and Systems Operations

Exhibit II-9 shows the market growth forecasts for network services and systems operations between 1991 and 1996. Growth in both of these delivery modes is forecast to be appreciably lower in the process manufacturing sector than in the discrete manufacturing sector.

In particular, this is true for the usage of electronic data interchange. In the discrete manufacturing sector growth in electronic data interchange is being largely driven by the major manufacturers' need to link to their key suppliers which becomes increasingly important with the use of just-in-time procedures. In the process manufacturing sector, there is less demand for electronic data interchange between manufacturer and supplier, and even between manufacturer and wholesaler. The major driving force tends to be the major retailers. However, some companies have found that even electronic data interchange links with major retailers have been characterised by comparatively low take-up of the service.

EXHIBIT II-9

Market Forecasts, 1991-1996
Network Services and Systems Operations
Process Manufacturing Sector, Western Europe



Overall, comparatively low levels of growth in EDI are anticipated by users in the process manufacturing sector as indicated in Exhibit II-10, and the pattern of usage of EDI is quite different from that found in the discrete manufacturing sector.

EXHIBIT II-10

Planned Use of EDI: User Perception
Process Manufacturing Sector, Western Europe

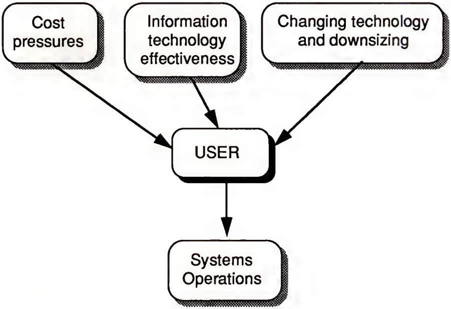
Links To Customers	Moderate
Links To Suppliers	Low

The driving forces encouraging the process manufacturing sector to adopt systems operations are shown in Exhibit II-11. Although not to the same extent as the discrete manufacturing sector, the process manufacturing sector has its own cost pressures. These arise from factors such as attempts by central governments to reduce health-care expenditure, from own-label goods, and from rising oil prices. The subsectors particularly affected in the process manufacturing sector are the low value-added

businesses such as petrochemicals, the processing of rubber and plastics, and man-made fibres. Accordingly, these are the sectors which are most susceptible to use of systems operations. Other factors which may encourage companies in the process manufacturing sector to adopt systems operations include the high levels of system redevelopment taking place and the changing nature of the equipment platform used, leading to a need for transition management services.

EXHIBIT II-11

Increasing Use of Systems Operations
Process Manufacturing Sector, Western Europe


Cost pressures
Information technology effectiveness
Changing technology and downsizing
USER
Systems Operations

F

User Pressures

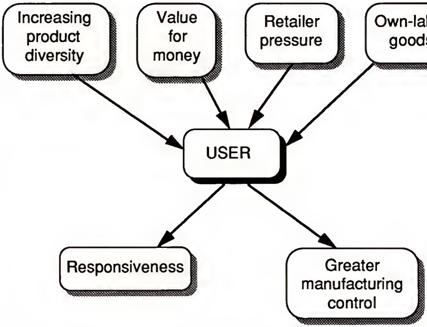
As illustrated in Exhibit II-12, much of the process manufacturing industry is moving into a more competitive environment. This is characterised by the developments in the food industry where manufacturers are coming under increasing pressure from supermarkets and the major purchasing co-operatives. This pressure can take several forms. For example, own-label goods have large market shares in some product areas, and retailers are frequently looking for special packaging or tighter delivery schedules from their suppliers. These pressures are forcing food manufacturers upmarket with the corresponding need to develop high levels of quality and to produce a more diverse range of products in smaller batches.

The result is that manufacturers are seeking improvements in manufacturing control, particularly in areas such as:

- Quality management and lot traceability
- Tighter monitoring of production against plan
- More complete production scheduling

EXHIBIT II-12

User Pressures
Process Manufacturing Sector, Western Europe



These can be achieved partially by the implementation of production management systems and substantially through their subsequent integration with process control via integrated quality management and production supervision and control systems.

Some of the major technological trends in the process manufacturing sector are shown in Exhibit II-13. One of the consequences of the process manufacturing sector adopting production management software products much later than the discrete manufacturing sector is that technology has progressed in the intervening period. As a result the process manufacturing sector has more sophisticated architectures in mind into which to introduce its applications.

EXHIBIT II-13

Technological Trends
Process Manufacturing Sector, Western Europe

Trend	Likelihood of Adoption
Standardised Systems	High
Relational Databases	High
Downsizing	Moderate
Distributed Systems	Moderate

For example, a plan to introduce computer-integrated processing will typically exist before the first production management software product is implemented. Similarly the process manufacturing sector has a high expectation of using products based on a relational database. There is also a strong intention to standardize the information systems used across plants and subsidiaries. Obviously there are limits to the extent that this approach can be adopted given the widely differing processes which may be found within a large process manufacturing organisation, but where it is feasible, users will attempt to standardize on the information systems and packages used.

Initially many production management systems will be operated on a centralised basis with one system covering a number of plants. This will gradually change as distributed systems become a proven reality. However, this will always depend on the nature of the individual plant. Some process plants have production runs which continue for weeks, or even years, and have little need to constantly reschedule or monitor production. Other plants will be making a more rapid transition to short production runs, producing a greater variety of product, and will have a greater requirement for local production management and tighter control of product output.

As in other sectors, there is a general trend away from the use of mainframes. While the IBM AS/400 is one of the principal beneficiaries of this trend in the short-term, there are signs that the process manufacturing sector may adopt UNIX-based systems, such as the RS/6000, for commercial use comparatively rapidly.

G

Vendor Issues and Strategies

As shown in Exhibit II-14, equipment vendors figure prominently as suppliers to the process manufacturing sector, and have recently been very active in positioning themselves for the new wave of activity just commencing in the process manufacturing sector.

EXHIBIT II-14

Software and Services
Leading Vendors (1990)
Process Manufacturing Sector, Western Europe

Company	Estimated Revenues ($ Millions)
IBM	165
Nixdorf	95
CGS	70
Siemens	65
Bull	60

Includes industry-specific revenues only

The process manufacturing sector has been an area of traditional strength for vendors such as Digital and Hewlett-Packard with their experience in linking to process control and laboratory systems. To a certain extent, the same is true for Bull via its association with Honeywell's control activities, and Siemens, with its experience in automation and programmable logic controllers. These companies are now complementing this traditional expertise with production administration products for the process manufacturing sector.

However, IBM has been particularly active in positioning itself in the process manufacturing sector and has developed an exclusive product portfolio including its innovative production supervision and control product called POMS (Process Operations Management System).

Many of the larger professional services vendors, with a few exceptions such as SD-Scicon and GFI, have tended to specialize more strongly in the discrete manufacturing sector, and are currently not particularly strong in the process manufacturing sector.

Application software product vendors have traditionally had a very low presence in the process manufacturing sector in industry-specific applications, with the majority of production administration systems being written in-house. Of course, this situation is now starting to change dramatically.

As the market for software and services in the process manufacturing sector enters a growth phase, vendors must seek to establish themselves as leading suppliers to this industry and build-up market share. Accordingly the main issues in the marketplace are to establish credibility in the sector and successfully introduce new products and services, as shown in Exhibit II-15.

EXHIBIT II-15

Vendor Issues
Process Manufacturing Sector, Western Europe

- Introducing new products and services
- High user acceptance of open systems
- Service development

For example, many vendors of production management systems introduced products for the process manufacturing sector in 1990 and many more are announcing products in 1991. Examples of vendors who announced production management systems for the process manufacturing section in 1990 include ASK with Manman/Process, SD-Scicon via its partnership with Pioneer Computer Systems concerning the Promix product, and IBM with Marcam's Prism product. AT&T Istel acquired Deritend and its ProcessMarc package in 1989.

Vendors likely to announce versions of their products specifically tailored for the process manufacturing sector during 1991 include:

- CINCOM
- SSA
- Pansophic
- SAP
- D&B Software

Hence, this market will become very competitive over the next twelve months and there is no guarantee that the leading vendors in the process manufacturing sector will be the same as the leaders in the discrete manufacturing sector. Indeed, while it is important for vendors to be able to point to a sizeable installed base, vendors will need to dissociate themselves from their activities in the discrete manufacturing sector and demonstrate their knowledge of, and the suitability of their product for, the process manufacturing sector.

A further complication is the high user acceptance of UNIX in the process manufacturing sector. It will be difficult for many vendors to decide when to introduce a UNIX-based approach. It is likely that comparatively large companies in the process manufacturing sector will adopt UNIX for commercial applications earlier than will their counterparts in the discrete manufacturing sector.

For the professional services vendors, the main challenges are to respond quickly to the emerging opportunities in the process manufacturing sector by building up their product and service portfolios and especially their consultancy skills for the sector, and by establishing their credibility within the industry.

The basic generic strategies being adopted by the various types of vendor are shown in Exhibit II-16.

EXHIBIT II-16

Vendor Strategies
Process Manufacturing Sector, Western Europe

Vendor Type	Strategy
Major Equipment Vendors	Account Control Framework for Integration Partnerships
Professional Services Vendors	Consultancy Systems Integration License "Best of Breed"
Application Software Product Vendors	Credibility Partnerships New Technology

The major equipment vendors are targeting overall systems integration within the large process manufacturing companies. Much of their success will depend on the quality of their account management and the quality of their industry consultants. Overall, these vendors are well positioned in the process manufacturing sector. They typically have architectures and enablers which provide a framework for evolving towards computer-integrated processing and they have built up good basic portfolios of products and services via partnerships with application software product vendors and professional services vendors. While the major equipment vendors are endeavouring to extend their own in-house capabilities, they are currently very dependent on professional services vendors for their implementation capability.

There are indications that the potential importance of UNIX in this sector is recognised by the equipment vendors. Many of the middle-ranked equipment vendors already offer UNIX-based solutions primarily to medium-sized users. The leading equipment vendors are likely to move to UNIX comparatively rapidly.

The major professional services vendors are also targeting systems integration within the large process manufacturing companies. However, they appear in many cases to have been slower than the equipment vendors in licensing products and setting up partnerships to assemble their product/service portfolios. It is important for the professional services vendors to offer high quality industry consultancy and to have access to "best of breed" application software products.

Industry-specific production management systems for the process manufacturing sector are a comparatively recent development, and so the primary focus of the application software product vendors must be to establish their credibility in the industry and build up market share. Partnerships can be a key factor in establishing credibility.

The complicating factor is again the decision regarding the timing of the development of UNIX-based systems. Introducing new products into new sectors using new technology is obviously an extremely high-risk approach, but the demand for UNIX-based systems is likely to be considerable in the medium term.

Exhibit II-17 summarises vendors' views of the extent to which they need to further develop their product/service portfolios.

EXHIBIT II-17

Need To Develop Product/Service Portfolio Process Manufacturing Sector, Western Europe

	Vendor Type		
Delivery Mode	Equipment Vendors	Professional Services Vendors	Application Software Product Vendors
Application Software Products	Medium/High	Medium/High	Medium/High
Professional Services	High	Low	Medium
Systems Integration	High	Low	Medium

The major equipment vendors have assembled good basic portfolios of application software products for the process manufacturing sector. Their approach to the sector is essentially one of providing consultancy, assisting the user to identify the most appropriate applications, and helping the company to choose "best of breed" products. This means that it is desirable to offer the user a choice of product for each application area to give the appearance, at least, of best fit to the user's individual circumstances. Also the vendors are endeavouring to offer total computer-integrated processing frameworks and so ideally need to be able to offer products covering a wide range of applications. Both these factors point to a continuing high level of need for application software products by the equipment vendors. The equipment vendors tend to favour licensing and partnerships for access to software products, but there is now an increasing trend towards minority stakes and, in some cases, acquisition.

The major equipment vendors are also keen to develop their capabilities in professional services and systems integration. Initially they are becoming extensively involved in consultancy, while subcontracting the bulk of low-level implementation and application integration activity. In the U.S., IBM, in partnership with Coopers & Lybrand, has formed a joint venture company—Meritus Consulting—specifically to target computer integrated manufacturing in the process manufacturing sector. Pharmaceuticals companies are seen as an area of initial emphasis.

The major professional services vendors consider themselves experts in systems integration and professional services. However, there may be some acquisition activity to supplement existing skills where necessary. Some of the professional services vendors have been comparatively slow in developing their portfolios for the process manufacturing sector and still need to arrange licensing, or partnerships, that will provide access to "best of breed" application software products.

Some application software product vendors see the need to extend the scope of their offerings into professional services, though this is most likely to be achieved through collaboration. ASK's relationships with Ingres and EDS is one example of a vendor moving in this direction.

H

Logistics

The business pressures which are driving process manufacturing companies to examine their logistics systems are listed in Exhibit II-18.

EXHIBIT II-18

Business Pressures: Logistics
Process Manufacturing Sector, Western Europe

- "1992"
- Customer service is paramount
- Cost pressure

Firstly, there is the impact of "1992". This has encouraged companies to re-evaluate their presence in each of the national markets of the Economic Community. It has led to a significant number of acquisitions by organisations such as BSN, Nestlé, and Unilever as they seek to dominate their chosen market sectors on a pan-European basis. Finally, as these national markets become increasingly homogeneous in terms of regulations and buying characteristics, it will encourage organisations such as Nestlé to review the siting of their manufacturing and warehousing activities. In theory at least, the impact of "1992" should encourage manufacturers to rationalise their activities and concentrate both production and distribution at fewer, more efficient sites.

Customer service is especially important in the food and drink sector. Here the manufacturers are facing considerable pressure from the major retail chains for "just-in-time" deliveries aimed at specific time windows. There are also pressures for greater product and packaging variability.

Having taken steps to reduce their manufacturing costs in recent years, manufacturers are now finding that their distribution networks are a major source of cost.

The overall levels of interest in logistics systems within the key subsectors of the process manufacturing sector are identified in Exhibit II-19.

EXHIBIT II-19

Level of Demand for Logistics Systems Process Manufacturing Sector, Western Europe

Subsector	Level of Demand
Food and Drink	Medium
Pharmaceuticals	Low-Medium
Petrochemicals	Low

The food and drink subsector is the area of highest demand since it faces the greatest pressures from its key customers—the major retail chains.

There are three ways in which food and drink companies handle their distribution logistics:

- Outsourcing of entire distribution operation
- Direct plant shipments from factory
- Own-account distribution operations

Overall the trend is towards a reduction in the proportion of companies using own-account distribution operations. Historically, food and drink manufacturers sited their depots adjacent to the major centres of population to maintain proximity to the small retail outlets served. However, the food and drink sector is increasingly dominated—with the notable exception of Italy—by the major retail multiples that expect distribution to their own major distribution depots. This has removed the need for many manufacturers to maintain their secondary distribution networks. Indeed some companies in the food and drink sector are now evaluating the possibility of moving entirely to direct plant shipments.

Other companies see their distribution network as a source of competitive advantage and are reviewing their logistics capability accordingly.

The major opportunities for software and services vendors within the logistics function of process manufacturing companies are identified in Exhibit II-20.

EXHIBIT II-20

Major Opportunities in Logistics Process Manufacturing Sector, Western Europe

- Long-term planning systems
- Warehouse management/automation
- Integration of major applications
- Provision of performance indicators

The first major opportunity area is in forecasting/scheduling software for both long-term planning—a month ahead—and short-term planning. The major impact on stock-holding costs of finished goods lies in correctly predicting customer demand. A number of software products are now available which assist planning across multiple manufacturing and distribution sites, and some use knowledge-based software to take into account local factors influencing demand.

There are also opportunities for suppliers of warehouse management systems, and automated warehousing is being adopted for distribution centre to distribution centre operations. To improve warehouse operative efficiency, many systems now incorporate radio transmission of picking lists to hand-held units. Other systems enable multiple orders to be picked simultaneously to reduce operative movement around the warehouse and so increase efficiency.

In the past, many information systems supporting logistics operations have existed as "islands of automation", such as:

- Forecasting & planning
- Warehousing
- Transport management
- Customer service management

There is now a need to integrate these and to measure the performance of the logistics operation as a whole.

I

Key Opportunities

The key opportunities for software and services vendors in the Western European process manufacturing sector are shown in Exhibit II-21. Exhibit II-22 highlights the principal application software product opportunities.

EXHIBIT II-21

Key Opportunities
Process Manufacturing Sector, Western Europe

- Production administration software
- Professional services/consultancy
- Integration of production management and process control systems
- Improved logistics systems
- Open systems

The major opportunity in the process manufacturing sector in the short term is the growing market for production administration software, as users switch from systems developed in-house.

Unlike in the early days of the production administration system market in the discrete manufacturing sector, where systems were installed in complete isolation, the process manufacturing sector is much more aware of the need to implement production management as one component of an integrated system. The result is a greater level of commitment to open systems and UNIX, and substantial use of consultants to assist in planning the company's information systems requirements and approach.

Once the production administration systems have been implemented, the integration of these systems with supervisory control and data acquisition (SCADA) systems and process control equipment will become a major area of opportunity for software and services vendors.

Another emerging opportunity is the need for more comprehensive and better-integrated logistics support. Once the production function is under tight control, the next area for improvement in terms of increased customer responsiveness and greater efficiency is the distribution logistics function.

EXHIBIT II-22

Key Opportunities: Application Software Products Process Manufacturing Sector, Western Europe

- Production management
- Quality systems
- Process operations management
- Supervisory control and data acquisition
- Decision support

Within application software products, the major opportunity over the next few years will be for production management systems. However there will also be high levels of demand for quality systems (particularly in-line quality monitoring), supervisory control and data acquisition (SCADA) systems, and production supervision and control systems.

Quality systems will be used to measure the composition of both raw materials and final products, and feed the results instantaneously to both the process operator and the production management system. Production supervision and control systems, such as the IBM POMS product, ensure that the correct operating procedures are followed as well as enabling both the materials used and the plant operating conditions to be closely monitored.

Once large quantities of data start to become available from the shopfloor, there will be a need for some form of decision support system to prevent information overload on users.

III

European Software and Services Overview

A

European Overview

As shown in Exhibit III-1, the overall market for software and services within the Western European Process Manufacturing Sector is forecast to grow strongly between 1991 and 1996. Indeed this trend is so marked that many of the software and services vendors who have traditionally specialized in the discrete manufacturing sector are now looking to the process manufacturing sector for their short-term growth.

The figures shown in Exhibit III-1 include only end-user industry-specific revenues. This means that revenues for systems software and cross-industry applications, such as accounting, are excluded. Examples of applications for which revenues are included are production management and Supervisory Control And Data Acquisition (SCADA) systems.

As shown in Exhibit III-2, the process manufacturing sector is again dominated by the equipment vendors such as IBM, Siemens Nixdorf, Bull and Unisys. In particular, the process control area is a traditional strength of companies such as Bull and Digital. On the other hand, the CAD suppliers such as Prime/Computervision and Intergraph are lower down in the ranking. Process plant design obviously has a significant role in this sector but not quite the same prominence as product design in the discrete manufacturing sector. In 1990, Digital significantly increased its presence in the process manufacturing sector in Western Europe with the acquisition of Kienzle from the Mannesmann Group.

Many of the major professional services vendors such as CGS and the Sema Group figure strongly as suppliers to the process manufacturing sector. However, many of the European professional services companies have so far specialised predominantly in the discrete manufacturing sector and have had little involvement with the process manufacturing sector. In contrast, one vendor with a greater emphasis on the process manufacturing sector is SD-Scicon, together with its subsidiary GFI.

Logica is another professional services vendor with a strong background in the process manufacturing sector.

Until 1990, spending on software products—apart from corporate accounting systems—has been quite low in this sector. However, application software product vendors are now starting to focus on the process manufacturing industry as packages have become more important to users.

EXHIBIT III-1

Software and Services Market Forecast, 1991-1996 Process Manufacturing Sector, Western Europe

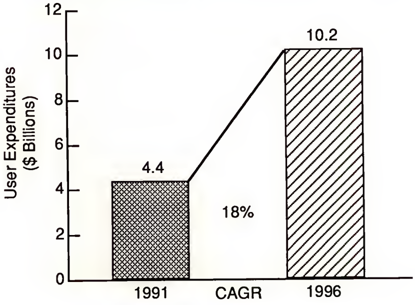


EXHIBIT III-2

Leading Vendors, 1990
Process Manufacturing Sector, Western Europe

Rank	Company	Market Share (Percent)	Estimated Revenues ($ Millions)
1	IBM	6	230
2	Nixdorf	3	120
3	CGS	3	95
4	Siemens	2	80
5	Sema Group	2	75
6	Sligos	2	70
7	Prime	2	65
8	Bull	2	60
9	SD-Scicon	2	60
10	Unisys	1	50
11	Olivetti	1	50
12	GFI	1	45
13	Hoskyns	1	45
14	Digital	1	40
15	Logica	1	40
16	EDS	1	40
17	SAP	1	40
18	*Mannesmann Kienzle	1	35
19	Intergraph	1	35
20	PSI	1	25
	Other	65	2,350
	Total	100	3,650

* Now Digital Kienzle

B

Key Industries

Exhibit III-3 shows the main subsectors which make up the process manufacturing industry. The three principal sectors are:

- Food and beverages
- The chemical industry (including pharmaceuticals)
- Oil and gas production

The European food and beverages industry is very heterogeneous and few products are marketed at long distances. Consequently Unilever and Nestle, which are the leaders in this sector in Western Europe, both have in excess of 200 processing plants in Europe.

As in other industries, there is considerable refocusing going on within the sector, resulting in high levels of merger and acquisition activity. Two of the major trends in the food sector are the increasing demand for highly processed foods, and the increasing variety of product required to maintain consumer interest. Both of these trends point to a need for greater control of the manufacturing process.

Another very important trend in the food sector is the increasing strength of the major retail distributors compared to the manufacturers. The leading supermarket chains play a key role in the United Kingdom, while purchasing co-operatives are now in a strong position in Germany and France. One worrying aspect from the manufacturers' perspective is the increasing market share being taken by retailers' own brands, for example, Carrefour in France.

The major trend in the chemicals sector over the past decade has been the desire by many of the leading chemical companies across Europe to move downstream and concentrate on the more specialised and lucrative value-added product areas such as paints and pharmaceuticals.

Indeed, just as the period of oversupply in basic chemicals in Europe seemed to be coming to an end, the Gulf War adversely affected the petrochemical sector. This, coupled with the widespread recession, has led to a number of announcements of plant rationalisation and investment cutbacks by leading companies such as ICI and BASF.

Another trend in the chemical sector is a substantial move towards safety and environmental protection. The United Kingdom was initially thought to be lagging in this respect, but ICI towards the end of 1990 made a major policy statement aimed at significantly reducing the levels of waste product from its plants worldwide.

The pharmaceuticals sector invests a high proportion of its revenues, nearly 15%, in R&D, and is understandably concerned with maximising the returns from any new drugs, before patent protection expires. In addition however, the European chemical companies are facing increasing competition from U.S. and Japanese competitors, and are facing ever increasing pressure for cost containment, typically via generic substitutes, from government departments alarmed at increasing health care costs.

EXHIBIT III-3

Production by Western European Process Manufacturing Industry by Subsector (1990)

Subsector	Proportion of Western European Process Manufacturing Sector Production
Food & Drink	30%
Chemicals Industry	22%
Oil & Gas	11%
Metal Production & Processing	10%
Rubber & Plastics	7%
Non-Metallic Mineral Products	7%
Paper & Paper Products	5%
Tobacco	3%
All Others	5%

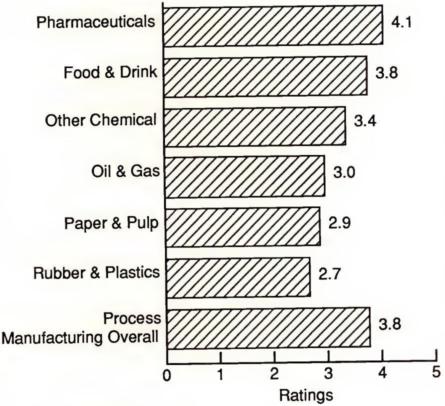
Total Production = ECU 1,500 Billion
($ 2,000 Billion)

Source: INPUT Estimate, EEC

Towards the end of 1990, a number of software and services vendors, each with a significant presence in the process manufacturing sector, was asked to rate the growth prospects for each of the major industrial subsectors. The results are shown in Exhibit III-4.

EXHIBIT III-4

Growth Prospects by Subsector



Scale of 1-5: 1=Poor
5=Excellent

Response to the question: "How do you rate the growth prospects for software and services in each of the following sectors over the next few years?" Sample of fifteen software and service vendors. Standard error = 0.2.

Firstly, the overwhelming conclusion was that the overall process manufacturing sector was now a very promising sector to target. This view was particularly pronounced among the equipment vendors and application software product vendors. The latter group, in particular, had found the discrete manufacturing sector an increasingly difficult market in 1990, and have been turning their attention towards the process manufacturing sector.

Within the process manufacturing sector, the pharmaceuticals and food and beverages subsectors were rated most highly. However, while the pharmaceuticals sector was regarded uniformly well by all categories of vendors, professional services vendors showed markedly less enthusiasm for the food and beverages sector than did the application software product and equipment vendors. Some professional services vendors felt that while the food industry is tending to use third parties more than in the past, the sector is still very fragmented and difficult to penetrate.

IV

Country Forecasts

A

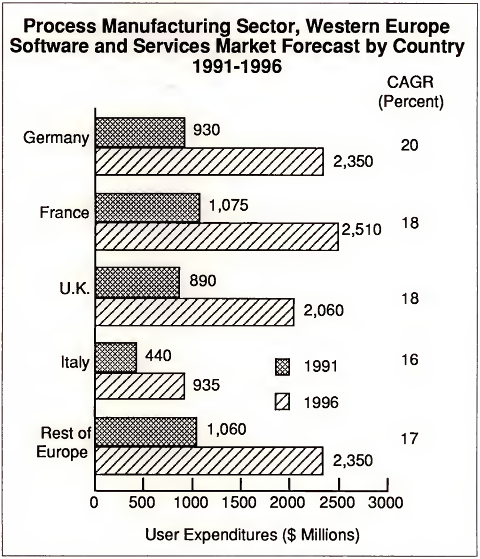
Overview

The relationships between the national markets for software and services in the process manufacturing sector show a number of contrasts from those for the discrete manufacturing sector.

Firstly, the largest national market is France, rather than Germany. Secondly, while Germany is the fastest growing national market and is expected to ultimately become the largest market in Western Europe, growth rates are expected to be less polarised in the process manufacturing sector, as shown in Exhibit IV-1, than was the case in the discrete manufacturing sector. This is largely because the major subsectors contributing to growth in the software and services market such as pharmaceuticals and food and beverages are comparatively recession proof. In addition, the United Kingdom which is showing the worst signs of recession, has less dependence on upstream petrochemicals than France and Italy.

The software and services revenues shown for each of the countries in the following sections, include industry-specific revenues only. This means that in the software products delivery mode, for example, revenues for systems software and cross-industry application software products are excluded from the figures shown.

EXHIBIT IV-1



B

Germany

The chemical industry in Germany is very strong and accounts for 28% of total chemical production by value within the European Community. The three leading chemical companies in Europe: BASF, Hoechst, and Bayer, are all German in origin. While these companies have been increasing their emphasis on speciality chemicals, they are still heavily involved in basic chemical production and, influenced by the increase in oil prices, have had a downturn in profitability in 1990 and 1991.

These companies are already pan-European, if not global, in outlook with many plants scattered around Europe and have an increasing need to co-ordinate their plants via common administrative systems.

Acceptance of packaged production management systems is likely to start later in Germany than in the United Kingdom where the process is strongly underway. As a result, a number of non-German software product vendors perceive a much lower level of domestic competition in the process manufacturing sector than in the German discrete manufacturing sector and are hoping to meet with more success in this sector. However, German vendors such as SAP can be expected to market versions of their products tailored to the needs of the process manufacturing sector during the course of 1991.

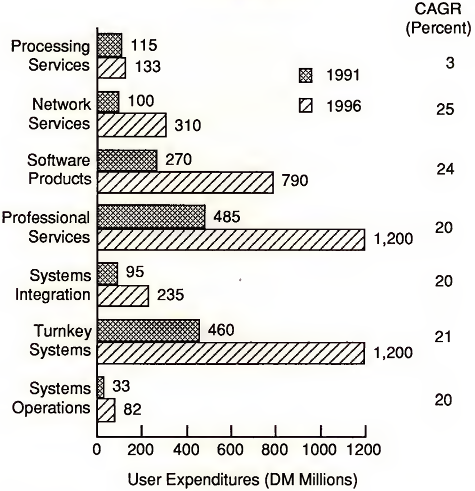
The market forecasts for software and services in the German process manufacturing sector are provided by delivery mode in Exhibit IV-2. High growth rates are forecast for software products in Germany over the period 1991-1996 as the move to production management systems especially designed for the process manufacturing sector gets underway and users come to accept packaged solutions in this area.

Growth in professional services and systems integration will follow later on in the forecast period as users start to integrate these systems with other functions.

Another significant trend in Germany is the importance now being attached to environmental considerations. The chemical industry, especially in the former East Germany, is potentially one of the prime offenders.

EXHIBIT IV-2

Process Manufacturing Sector, Western Europe Software and Services Market, 1991-1996 Germany



The leading software and services vendors in the process manufacturing sector in Germany are shown in Exhibit IV-3. German equipment vendors such as Siemens Nixdorf are again important players in the process manufacturing sector. For example Datarat Systemberatung, a subsidiary of SNI, offers a system for the chemical and pharmaceutical industries based around Nixdorf's Comet product. The system is offered in five languages and is available under UNIX. It is probable that UNIX-based application software products will meet with more rapid acceptance in the process manufacturing sector than has been the case so far in the discrete manufacturing sector, with the obvious exception of CAD systems.

EXHIBIT IV-3

Process Manufacturing Sector, Germany
Leading Vendors, 1990

Rank	Company	Market Share (Percent)	Estimated Revenues (DM Millions)
1	Nixdorf	9	115
2	Siemens	9	110
3	IBM	7	85
4	SAP	4	50
5	PSI	4	45
6	Prime	3	40
7=	*Mannesmann Kienzle	3	35
7=	SCS	3	35
9=	Ploenzke	2	20
9=	Intergraph	2	20
	Other	54	725
	Total	100	1,280

* Now Digital Kienzle

In 1990 Digital acquired Kienzle from the Mannesmann Group, strengthening the company's position in a number of vertical markets throughout Germany.

While SAP will undoubtedly be a formidable competitor in the process manufacturing sector, the company is lagging slightly in the development of process industry-specific software, and may be more vulnerable than in the discrete manufacturing sector.

In 1990 Intergraph, which is very successful in Germany, opened an office in East Germany to offer systems specifically for the process manufacturing sector.

C

France

France has two state controlled oil groups in Total and Elf Aquitaine, both of whom are attempting to move their activities further downstream into high value-added products. Elf is moving strongly into chemicals and pharmaceuticals while Total is still much more dependent on its exploration, production, and refining activities.

In the chemicals sector, the major French company is Rhône-Poulenc which has had problems in its traditional sectors such as man-made fibres, but is now increasingly focusing on its agrochemical and pharmaceutical interests.

In the food sector, BSN is the third largest European food company. Over the past few years, the company has had an aggressive acquisition strategy in Europe acquiring, for example, the HP and Lea & Perrins sauce businesses in the U.K. and the Italian pasta producers Panzani, Agnesi and Ponte.

The market forecasts for software and services within the process manufacturing sector in France are shown by delivery mode in Exhibit IV-4. Exhibit IV-5 identifies the principal software and services vendors.

The leading vendors in the process manufacturing sector in France are the major professional services vendors such as Sligos and Cap Gemini, together with the process manufacturing specialists GFI.

The equipment vendors, IBM and Bull, also have a significant interest in the process manufacturing sector and can be expected to become a major competitive threat to the professional services vendors over the next few years, as they appear to have more advanced product portfolios for the process manufacturing sector.

EXHIBIT IV-4

Process Manufacturing Sector, Western Europe Software and Services Market, 1991-1996 France

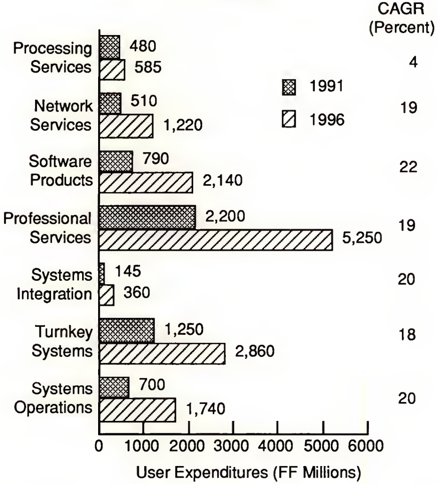


EXHIBIT IV-5

Process Manufacturing Sector, France Leading Vendors, 1990

Rank	Company	Market Share (Percent)	Estimated Revenues (FF Millions)
1	Sligos	7	360
2	CGS	6	300
3=	GFI	5	240
3=	IBM	5	240
5	Sema Group	3	150
6	ESIA	3	140
7	Bull	2	120
8	CGI	1	75
9	CISI	1	65
10	Groupe Concept	1	60
	Other	66	3,290
	Total	100	5,040

D

United Kingdom

Manufacturing industry in the United Kingdom is currently feeling the impact of the recession and, in some subsectors such as petrochemicals, the process manufacturing industry is no exception. For example, ICI has recently instructed its business units to cut costs and has cut £100m from the company's 1991 capital expenditure programme as part of a two-year "belt-tightening" period. Similarly, Exxon Chemicals is forecasting slower growth in basic chemicals and has halted work on construction of a £235 million ethylene plant in Scotland.

However, the food and drink industry remains strong and is largely regarded as recession-proof. The United Kingdom is also strong in pharmaceuticals which has similar characteristics.

Overall, the process manufacturing sector has been less badly affected by the recession than the discrete manufacturing sector, with only the petrochemicals sector showing real signs of distress and food and pharmaceuticals showing some resilience to the recession. Accordingly, a comparatively high annual average growth rate is forecast for the U.K. process manufacturing sector, as shown in the market forecasts provided in Exhibit IV-6. The leading vendors in the sector are shown in Exhibit IV-7.

EXHIBIT IV-6

Process Manufacturing Sector, Western Europe Software and Services Market, 1991-1996 United Kingdom

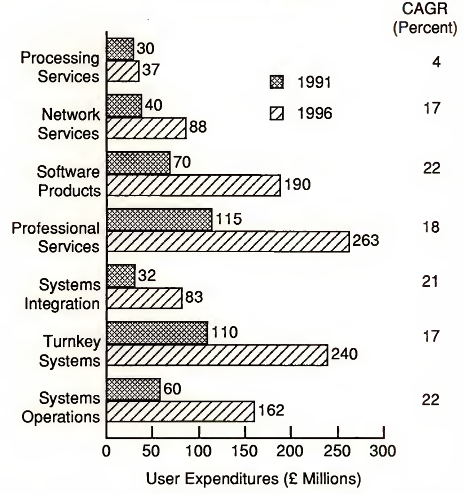


EXHIBIT IV-7

Process Manufacturing Sector, United Kingdom Leading Vendors, 1990

Rank	Company	Market Share (Percent)	Estimated Revenues (£ Millions)
1	IBM	7	28
2	Hoskyns	6	22
3	SD-Scicon	5	20
4=	Sema Group	4	17
4=	Logica	4	17
6	Prime	4	15
7=	ICL	3	10
7=	AT&T Istel	3	10
9	Digital	2	8
10	EDS	2	7
	Other	60	226
	Total	100	380

In the United Kingdom, there are a number of professional services vendors who have traditional strengths in the process manufacturing sector, frequently arising from their involvement on projects relating to oil and gas production in the North Sea. Examples include SD-Scicon and Logica. More recently AT&T Istel has diversified from its origins in the discrete manufacturing sector, and successfully assembled a portfolio of products and services for the process manufacturing sector.

IBM has also been aggressive in the U.K., where it conducted the first European launch of its Process Operations Management System (POMS) during 1990. The system is reported to have received a good reception and the initial implementations are underway.

The United Kingdom tends to be the European testing ground for the U.S. application software product vendors, and so is ahead of the other

major European countries in the acceptance of production management software products specifically designed for the process manufacturing sector.

E

Italy

During 1990, the Italian chemicals subsector was dominated by the controversy over the ownership of Enimont. Enimont is a joint venture between ENI—the state petrochemicals company—and Montedison, and accounts for 35% of output from the Italian chemicals subsector.

The bulk of the company's production and sales occur in Italy, at a time when presence in Far Eastern markets may have growing importance. The company is also heavily dependent on basic chemicals and other low value-added product areas such as bulk plastics and acrylic fibres. Accordingly, the company has a strong need to move its product lines further downstream and to diversify into foreign markets.

Pirelli, the Italian tyres company, is also trying to establish a stronger European position. Recently this included a hostile takeover bid for the Germany company, Continental.

The market forecasts for software and services within the process manufacturing sector in Italy are shown by delivery mode in Exhibit IV-8. The leading vendors in the sector are shown in Exhibit IV-9.

The Italian market for software and services in the process manufacturing sector is still relatively underdeveloped and is dominated by the equipment manufacturers: IBM, Olivetti, Bull, and Unisys; together with a group of professional services vendors led by Finsiel and CAP Gemini.

Sime is a subsidiary of Enimont and the bulk of its services comprise the provision of information systems to its parent company and fellow subsidiaries.

EXHIBIT IV-8

Process Manufacturing Sector, Western Europe Software and Services Market, 1991-1996 Italy

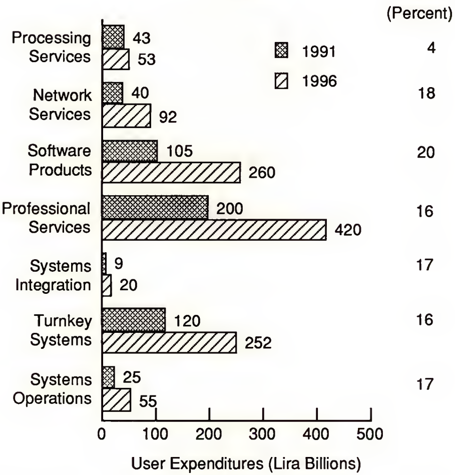


EXHIBIT IV-9

Process Manufacturing Sector, Italy
Leading Vendors, 1990

Rank	Company	Market Share (Percent)	Estimated Revenues ($ Millions)
1	IBM	10	45
2	Olivetti	9	42
3	Finsiel	5	22
4	Bull	2	9
5=	CGS	2	8
5=	Unisys	2	8
5=	Syntax	2	8
5=	Sicit	2	8
9	Andersen	2	7
10	Sime	1	6
	Other	63	292
	Total	100	455

V

Key Delivery Modes

A

Overview

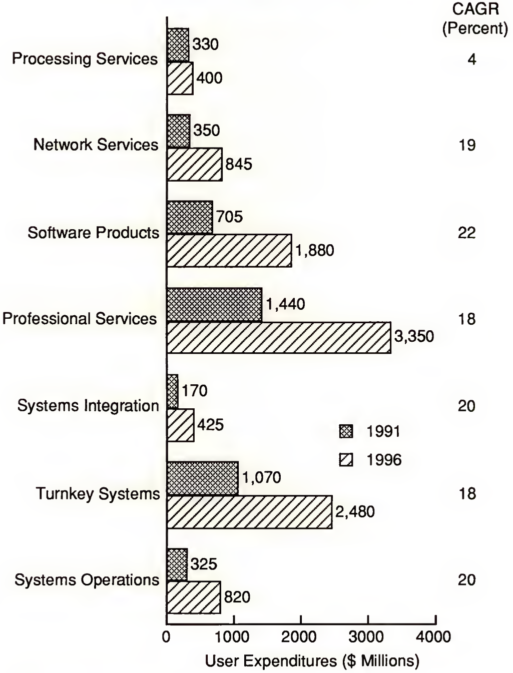
The process manufacturing sector is forecast to show a comparatively high level of growth between 1991 and 1996. This growth is being fuelled by a need for improved production management systems with the resulting purchase of packaged software. In the longer term, the growth will be sustained by integration of these systems with process control applications. This will lead to a levelling out of growth rates between the various delivery modes, as shown in Exhibit V-1. Turnkey systems and applications software products will have an initial burst of activity, subsequently followed by increased growth in professional services and systems integration.

Systems operations will also show substantial growth, influenced by increasing cost pressures on companies and by possible dramatic changes in applications and the technology on which these are based.

For now, electronic data interchange will show appreciably lower levels of growth in the process manufacturing sector compared to the discrete manufacturing sector.

EXHIBIT V-1

Process Manufacturing Sector, Western Europe Software and Services Market Forecast By Delivery Mode, 1991-1996



Overall CAGR = 18%

B

Software Products

Only revenues from industry-specific application software products are included in INPUT's forecasts for the process manufacturing sector. Revenues from systems software and cross-industry applications are excluded.

Typical industry-specific applications for the process manufacturing sector include:

- Production management
- Supervisory control and data acquisition (SCADA)
- Shopfloor data capture for manual input and time and attendance recording
- Quality systems
- Maintenance management
- Production supervision and control
- Transport management

These are delivered via turnkey system and applications software product delivery modes, with applications such as SCADA and production supervision and control tending towards the turnkey end of the spectrum.

Exhibits V-2 and V-3 show users' and vendors' perceptions of some of the leading trends in software products. A major trend, reported by both users and vendors, is the shift to the use of standard software packages.

This is particularly true in the case of production management systems. Until 1990, the majority of production management systems used in the process manufacturing sector were developed in-house by users. Few software product vendors who served the discrete manufacturing sector had appropriate products for the process manufacturing sector.

The considerable growth taking place in the process manufacturing sector is clear from both the users' perspective shown in Exhibit V-2, and the vendors' viewpoint shown in Exhibit V-3. However, on the vendor side, the level of increasing demand varies quite noticeably by vendor category as shown in Exhibit V-4. Professional services vendors have considerably lower levels of expectation than either application software product vendors or equipment vendors. This suggests that the latter categories may be proving the more successful distribution channels at the present time.

EXHIBIT V-2

Software Product Trends: User Perception Process Manufacturing Sector, Western Europe

Trend	User Rating Profile				
	1	2	3	4	5
Increasing reliance on packages	-	-	-	2	3
Implementation of production management systems	-	-	-	1	4
Standardised systems across each factory	-	-	2	1	2
UNIX-based systems at production management level	1	1	-	1	1
Distributed production management systems	2	-	-	1	1

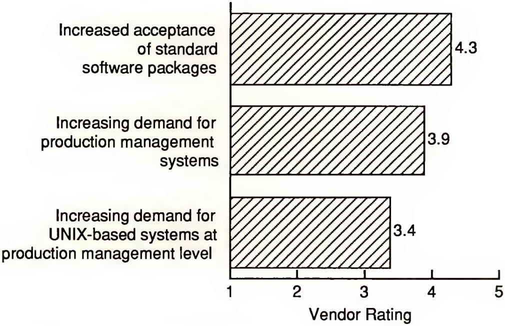
Scale of 1-5: 1 = Not At All Likely, 5 = Very Likely

Likelihood of adoption of trend.

Sample of five process manufacturing companies.

EXHIBIT V-3

Software Product Trends: Vendor Perception Process Manufacturing Sector, Western Europe



Scale 1-5: 1 = Not at all, 5 = Very substantially

Response to question: "To what extent to you believe the following trends are taking place in the Western European process manufacturing sector?"

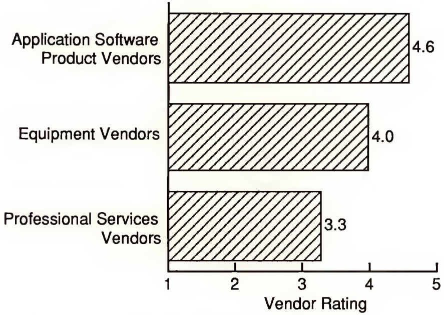
Sample of sixteen software and services vendors.

Average standard error = 0.2

In the last year, there have been a significant number of products launched specifically designed for the process manufacturing sector. This is particularly true in the United Kingdom where leading U.S. production management vendors such as ASK have been at the forefront of these announcements. It is also apparent that the majority of the traditional production management product vendors will endeavour to enter the process manufacturing sector. Many of the vendors who have yet to announce a process manufacturing industry-specific version of their product will do so during the remainder of 1991.

EXHIBIT V-4

Expectation of Increasing Demand for Production Management Systems by Vendor Category



Scale 1-5: 1 = Not at all, 5 = Very substantially

Sample of sixteen software and services vendors.

Average standard error = 0.2

This means that the battle for market share has now commenced in earnest. Few products have an established installed base in the process manufacturing sector.

A further level of complexity is added to the marketing and support of these products since a number of them will be launched under UNIX. There is a high level of support for open systems and UNIX within the process manufacturing sector at the production management level as shown by Exhibits V-2 and V-3. Certainly within the larger companies in the industry, there appears to be a much stronger drive to UNIX in the medium-term than is apparent in the discrete manufacturing sector.

However, while there are exceptions, vendors offering AS/400-based production management systems for the process manufacturing sector are not yet moving to offer UNIX-based versions of their products.

Many companies are installing production management systems on a centralised basis. This will change as distributed systems become proven products. Many users have a longer-term desire to move to a more decentralised approach.

Quality systems are another very important application in the process manufacturing sector because of the need for lot traceability. It is important to be able to identify any product discrepancies and the reasons why these occurred. Accordingly, there is a high level of demand for laboratory information management systems or in-line quality testing. Such systems analyse the quality of both raw materials and finished product, and feed the results to both the process operator and the production management system. The logging of process operating parameters such as temperature and pressure for each batch of product is also important both in ensuring that the process is operating within the preferred range and in improving product yields.

Maintenance management systems, while important for plant efficiency and safety, are extensively used in the process manufacturing sector and are not expected to be a significant growth area over the next few years.

C

Turnkey Systems

Supervisory control and data acquisition (SCADA) systems which link directly to the plant process controllers are instrumental in collecting data from the plant. This data can then be fed into mimic displays for plant operators and into higher-level applications.

The benefits of SCADA in providing traceability are illustrated by the following quotation from a medium-sized food processing company:

"Phase 2 will be a SCADA system capturing data from the processing equipment to link into the IBM AS/400 database. So if, for example, a bag of crisps is returned with a complaint, we will be able to detect what materials were used, where they came from and when they were delivered and used; what happened to the machinery during the course of production and where other items from that batch were delivered. This will give us full traceability of every bag of product".

One recent innovation, introduced by IBM in 1990, is their Process Operations Management System (POMS). This application resides between the SCADA and production management systems. It is a production supervision and control product and its principal purpose is to ensure that best practice is carried out by process operators leading to the production of consistently high quality product. The main functions of POMS are:

- Enabling production supervisors to work to a defined production schedule with full knowledge of the plant status at all times

- Providing the process operators with detailed instructions of the process steps to be followed
- Ensuring that process supervision is carried out
- Recording details of the materials used
- Logging details of the plant used and its operating parameters for each batch
- Updating inventory records

IBM POMS is reported to have received a good reception since its European launch. It was first launched in the United Kingdom in March 1990 with subsequent roll-out to the other major countries six months later. POMS was initially developed by IBM and INCODE in the U.S. utilising a consortium including Campbell Soup, Johnson & Johnson, Nestle Foods, Ralston Purina, and Smith Kline Beecham. The first installations in the United Kingdom are now underway with the implementation work being carried out by Logica.

CAD also has a role to play in the process sector in the design and ongoing maintenance of process plant.

D

Professional Services

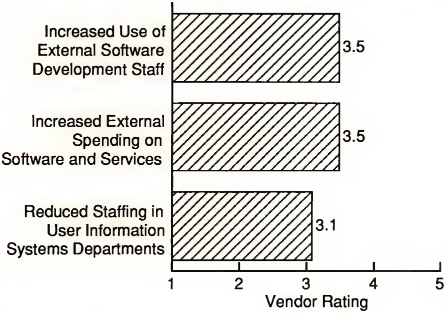
Users within the process manufacturing sector reported increasingly using third parties both for consultancy to help them establish their information systems plans and direction and for implementation and integration of their various applications. At the same time, some users have reported some reduction in the levels of in-house information systems development staff. On the other hand, some users still felt that any integration should be carried out in-house, since vendors were unlikely to understand the complexity of their plants.

The views of vendors are summarized in Exhibit V-5. Vendors clearly anticipate both increased usage of their professional services personnel and a degree of reduced staffing in user information systems departments.

However, the largest increases in external spending in the short term are likely to be for application software products rather than professional services. Professional services companies show a lower rating (3.2) than the other categories of vendor on this criterion.

EXHIBIT V-5

Professional Services Trends
Vendor Perception
Process Manufacturing Sector, Western Europe



Scale 1-5: 1 = Not at all, 5 = Very substantially

Response to question: "To what extent to you believe the following trends are taking place in the Western European process manufacturing sector?"

Sample of sixteen software and services vendors.

Average standard error = 0.2

E

Systems Integration

Exhibit V-6 shows the integration plans expressed by users. Users are undoubtedly moving towards greater degrees of integration and while some users are already integrating their systems, a typical large user in the process manufacturing sector is expecting to link the production management systems to the plant process control within the next one to five years. Correspondingly, users anticipate that their expenditure on the integration of systems will increase over the next few years.

As is the case in the discrete manufacturing sector, much of the integration work carried out will be merely linking together existing components rather than large-scale systems integration projects.

EXHIBIT V-6

User Integration Plans
Process Manufacturing Sector, Western Europe

	User Rating Profile				
Area of Integration	1	2	3	4	5
Fully Computer-Integrated Manufacturing	-	1	-	2	2
Integration of Production Management and SCADA Systems	-	-	1	2	2

Scale of 1-5: 1 = Not At All Likely, 5 = Very Likely

Likelihood of adoption of trend.
Sample of five process manufacturing companies.

Exhibit V-7 shows that in the contrast to the users who believe integration of SCADA and production management systems will not take place for several years, the majority of vendors believe integration projects are already taking place to a significant extent.

Several vendors stressed the importance of integration in "giving users the complete picture". Prior to integration, users often plan their production for the following day but only know if the plan was achieved several days later. Given the demands being placed on the sector for greater responsiveness, this is becoming an inadequate basis on which to manage the business.

One of the challenges for vendors in achieving integration between process control equipment and administrative systems is the variety, and in some instances, the antiquity of existing process control equipment. However, some users are showing an awareness of the need to replace some of their older process control equipment prior to attempting integration.

One example of a systems integration project in the process manufacturing sector is the factory management and plant control system implemented by Logica for Dunlop at its rubber mixing mill in Manchester. The system is based on a network of Digital minicomputers and comprises capabilities for:

EXHIBIT V-7

Timing of Integration of SCADA and Production Management Systems: Vendor Perception

Not Happening

- Companies are not integrating SCADA and production management systems.
- Production management and SCADA are still separate systems.

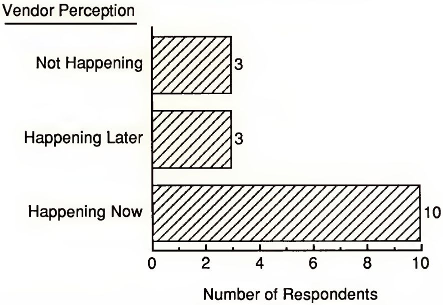
Happening Later

- Integration is very important, but at Stage 2.

Happening Now

- Integration is happening now.
- Integration of SCADA and production management is a new trend.
- Links between production management and SCADA are definitely happening to give users the complete picture.
- Manufacturers need greater integration to provide lower interests and more responsiveness.

Sample of 16 Software and Services Vendors



- production control including formulation development, capacity planning and production scheduling;
- quality control of raw materials and finished compounds;
- plant performance analysis;
- progress and quality control reporting;
- prompting and monitoring of shop floor operatives;
- direct control of plant according to schedule.

There are high levels of activity by the major equipment vendors such as IBM and Digital in consulting with user management and taking the lead in initiating systems integration projects.

In the U.S., IBM has established a joint venture with Coopers & Lybrand specifically to target computer-integrated manufacturing. Sub-sectors such as pharmaceuticals within the process manufacturing sector are among the initial target markets. This move emphasizes the importance of consulting activities aimed at user top management in generating systems integration projects.

F

Network Services

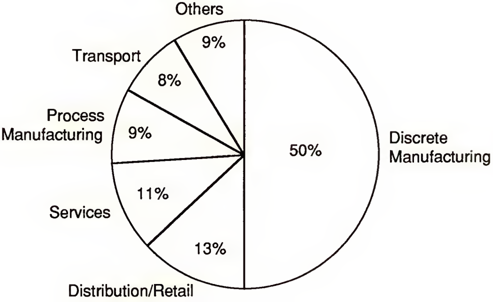
Exhibit V-8 shows the comparatively low levels of take-up of electronic data interchange in the process manufacturing sector compared to the discrete manufacturing sector.

In the discrete manufacturing sector, the use of electronic data interchange is frequently driven by the major manufacturers and their need to establish links with their key suppliers as a pre-requisite to the use of just-in-time techniques.

In the process manufacturing sector this is not the case. The principal drivers of the use of electronic data interchange are the large retailers such as the major supermarket chains.

EXHIBIT V-8

Western European EDI Markets by Vertical Sector, 1990



Total market = $50 million

There is quite a significant divergence between the views of users and those of vendors on the subject of electronic data interchange as shown in Exhibit V-9.

Vendors attached a significantly higher level of importance to electronic data interchange than did users. One user who had implemented EDI links with a number of major supermarket chains commented that even in this instance, usage had not yet grown as expected.

Vendors also believed that links to customers and links to suppliers were approximately equal in importance, while users tended to view links to customers more important than links to suppliers.

Taking the users' view, growth of electronic data interchange in the process manufacturing sector is forecast to continue to be much lower than in the discrete manufacturing sector. The key area of opportunity in the process manufacturing sector is forecast to be in establishing links between manufacturers and the major retail chains. Links to their suppliers and even wholesalers will be of less importance.

EXHIBIT V-9

Increasing Use of EDI
Process Manufacturing Sector, Western Europe

EDI Application	Use of EDI	
	Users	Vendors
Links To Customers	Medium	High
Links To Suppliers	Low-Medium	High

Sample of 16 software and services vendors and five users in process manufacturing sector.

G

Systems Operations

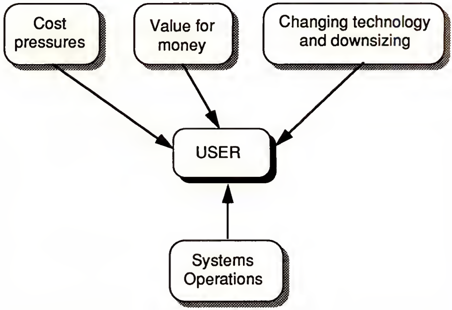
The process manufacturing sector, as is the case for the discrete manufacturing sector, is suffering from the recession. The impact of the recession is particularly noticeable in the upstream sectors such as petrochemicals, man-made fibres, and the processing of rubber and plastics.

While profitability in sectors such as food and pharmaceuticals remains comparatively high, these sectors cannot afford to be complacent given their own pressures from factors such as own-label goods and the preference of central governments for generic drugs.

Another factor which will encourage users in the process manufacturing sector to adopt systems operations is the high level of redevelopment of systems, often on a changing technology platform. One option is for a systems operations vendor to manage the existing system while user personnel carry out the redevelopment. Another option is to transfer the whole operation to a systems operations vendor.

EXHIBIT V-10

Increasing Usage of Systems Operations Process Manufacturing Sector, Western Europe



VI

Vendor Issues and Strategies

A

Vendor Issues

1. Overview

The major challenges facing vendors targeting the Western European process manufacturing sector are shown in Exhibit VI-1.

The process manufacturing sector is one that has been under-exploited by software and services vendors in the past. A very high proportion of the systems installed, particularly for production administration, have been developed in-house with little involvement from the software products and professional services vendors. This situation is now changing rapidly. The process manufacturing sector is increasingly using vendors for consultancy, is much more inclined to adopt packaged solutions, and will continue to use professional services vendors to integrate application areas.

The initial challenge facing many vendors is to establish their credibility in the marketplace by showing an understanding of companies' businesses and problems. This particularly applies to application software product vendors, many of whom will be seen as experts in discrete manufacturing but with little experience of the process manufacturing sector.

A related challenge is the need to build up market share quickly. At present there are few vendors truly established in the process manufacturing sector, and the next few years will be crucial in determining the market leaders.

While these issues are very challenging in their own right, two added complications are the need for vendors to acquire a pan-European presence mirroring the operations of their potential clients, and the changes in equipment platform taking place. Users are starting to move away from

mainframes and are showing a significant degree of enthusiasm for open systems and UNIX-based systems.

EXHIBIT VI-1

Vendor Challenges
Process Manufacturing Sector, Western Europe

- Speaking clients' language
- Marketing challenge of new products and services
- Expanding European coverage
- Links to process control equipment
- User downsizing

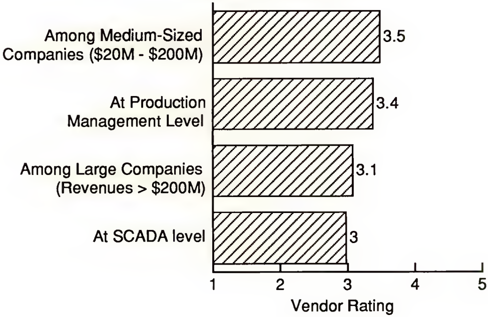
2. Acceptance of UNIX

In contrast to the discrete manufacturing sector, where UNIX is forecast to have greater impact at the shop floor system level; in the process manufacturing sector, UNIX is forecast to make the greater impact at the production administration level. This view is shared by both users and vendors. At the SCADA level, users feel that the impact of UNIX would be less due to interface requirements with proprietary process automation hardware.

The vendor survey, the results of which are summarised in Exhibit VI-2, again indicated a faster acceptance of UNIX-based systems by medium-sized companies. However the user survey indicated an acceptance of UNIX by large companies in the process manufacturing sector at very much higher levels than that in the discrete manufacturing sector. Some of the leading companies in the process manufacturing sector have a clear policy of moving to open systems and UNIX in the short or medium term.

EXHIBIT VI-2

Increasing Demand for UNIX-Based Systems Vendor Perception



Scale 1-5: 1 = Not at all, 5 = Very substantially

Sample of sixteen software and services vendors. Standard error= 0.2

Response to question: "To what extent to you believe there is an increasing demand for UNIX-based systems in the Western European process manufacturing sector?"

3. Suitability of Product/Service Portfolio

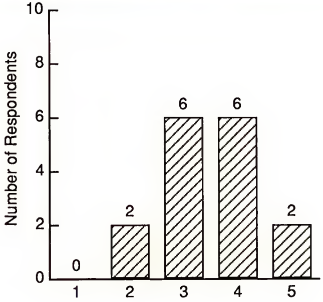
Exhibit VI-3 shows how software and service vendors rate the "completeness of their offerings" for the process manufacturing sector. The vendors in this sample are all active in the sector.

The aggregate position shown in Exhibit VI-3 shows a medium to high level of satisfaction with their offerings by vendors. However if this is broken down into the various categories of vendor, then the following picture emerges. Firstly, taking into account their current partnerships and relationships, the major equipment vendors rate themselves as highly self-sufficient. Secondly, the application software product vendors are only slightly less confident of their present product offerings. However, the professional services vendors and the second tier of equipment vendors only rate their current offerings as moderately complete.

This implies that in the newly emerging process manufacturing market, the major equipment vendors have been quick to position themselves and to develop relationships with application software product vendors and professional services vendors. Professional services vendors and the second tier of equipment manufacturers have been comparatively slow in developing their product/service portfolios.

EXHIBIT VI-3

Completeness of Vendor Offerings Process Manufacturing Sector, Western Europe



Scale 1-5: 1 = Inadequate on own, 5 = Self-sufficient

Response to question: "How complete are your offerings for the process manufacturing sector?"

Sample of sixteen software and services vendors.

Exhibits VI-4 and VI-5 show the level of need for application software products exhibited by vendors together with the means by which they intend to fill the gaps in their product portfolios.

Although the major equipment vendors have assembled sound product portfolios for the process manufacturing sector, they still need more application software products to provide in some instances an aura of choice for their clients and to extend the scope of applications covered. Equipment vendors tend to favour licensing and partnerships rather than their own product development. There is a trend towards increasing use of minority stakes and acquisitions, principally as a means of influencing

partners in their marketing strategies, and making the relationship a more exclusive one.

Professional services vendors have been slower in developing their product portfolios for the process manufacturing sector, though there are notable exceptions such as AT&T Istel. This means that there are some major professional services vendors who have yet to license basic application software products, such as production management systems, for the process manufacturing sector. A significant proportion of professional services vendors have high requirement for application software products. The favoured mechanisms for product acquisition are again licensing and partnerships, though there has been some company acquisition.

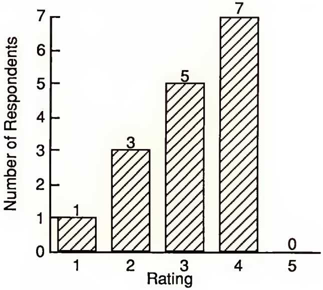
EXHIBIT VI-4

Need to Extend Offerings for Application Software Products
Process Manufacturing Sector, Western Europe

Not at all				Essential
1	2	3	4	5
We take an independent stance	We have just launched a production managment package.	We need complementary packages. We need a finite scheduling package. We are looking for a forecasting package.	There is a shortage of good quality assurance and process operations management systems.	

Sample Attitude Profile

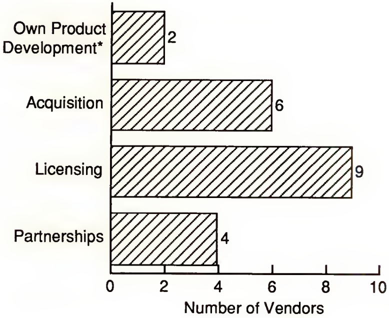
Sample of 16 Software and Services Vendors



Scale: 1-5
1 = Not at all, 5 = Essential

EXHIBIT VI-5

How Gaps In Applications Software Products Portfolio Will Be Filled



Sample of thirteen software and services vendors.

Multiple responses allowed.

*Responses from professional services/equipment vendors.

Applications software vendors who intend to extend their product range by own product development have been excluded from the sample.

Exhibit VI-6 shows the level of vendors' perceived need to extend their professional services offerings.

Equipment vendors are becoming more involved in professional services. For the major vendors, much of the early emphasis will be in the consultancy area, helping users to identify their critical success factors and how information systems can contribute to these areas. Much of the ensuing implementation and integration activity will then be subcontracted to professional services vendors. However, it is likely that the major equipment vendors will move into these areas over time.

Some of the application software product vendors will also develop into professional services via partnership arrangements. An obvious example is ASK's relationship with EDS.

EXHIBIT VI-6

Need to Extend Offerings for Professional Services: Process Manufacturing Sector, Western Europe

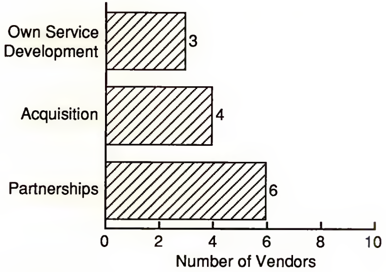
Vendor Type	Level of Need
Major Equipment Vendors	High
Application Software Product Vendors	Medium
Professional Services Vendors	Low

Systems integration is an important area for development by the major equipment vendors, since it is perceived as one of the keys to control of the major accounts. Systems integration enables vendors to establish a consultative relationship with clients while steering them to choose offerings from within their own framework or architecture. Hence a framework of enablers and a wide choice of applications software products are needed by the vendors. The detailed work required to implement and integrate the applications selected is usually subcontracted to professional services vendors. While partnerships are still the favoured means of extending vendors' systems integration capability, as shown in Exhibit VI-7, there is again a trend towards company acquisition.

Application software product vendors that want to have their products adopted by the major systems integration vendors are developing relationships with these companies.

EXHIBIT VI-7

How Gaps In Systems Integration Portfolio Will Be Filled



Sample of ten software and services vendors.

Multiple responses allowed.

B

Vendor Strategies

1. Equipment Vendors

The approach being taken by the major equipment vendors is shown in Exhibit VI-8. The major equipment vendors are well positioned to tackle the process manufacturing sector. Each vendor has an architecture and a range of enablers for computer-integrated processing, a good portfolio of application software products, established partnerships with professional services vendors, and industry consultants to drive their account management. They are targeting overall systems integration in the major accounts.

However, they are very dependent on application software product vendors and on professional services vendors.

Many of the second-tier equipment vendors are already offering UNIX-based products to medium-sized process manufacturing companies. Also, INPUT's research shows that a number of the major equipment vendors recognise the importance of UNIX to large companies in the process manufacturing sector. As yet, there is little sign of their product offerings reflecting this trend, but this may change in the short to medium

term. ASK has announced that its MANMAN/PROCESS system, developed in conjunction with Digital, will be converted for open systems in 1993 or 1994. This may lag behind market requirements.

EXHIBIT VI-8

Strategy: Equipment Vendors
Process Manufacturing Sector, Western Europe

- Account management
  - Industry consultants
  - Management workshops
- Overall systems integration
- Extensive partnerships with third-party vendors
- Major move to open systems

2. Professional Services Vendors

Many of the professional services vendors seem to have been caught off-guard by the changes taking place in the process manufacturing sector. While their targeting is similar to that of the major equipment vendors, they have been slower in licensing products and setting up the partnerships to develop their product portfolios. Accordingly some vendors are still putting together their basic portfolios for the process manufacturing sector.

Industry-specific consultancy is very important for professional services companies to build their credibility within the sector and to access a range of "best of breed" application software products, as illustrated in Exhibit VI-9.

EXHIBIT VI-9

Strategy: Professional Services Vendors Process Manufacturing Sector, Western Europe

- Developing systems integration capabilities
- Consultancy capabilities important
- Licensing "best of breed"

3. Application Software Product Vendors

Applications such as accounting and maintenance management have been purchased by the process manufacturing sector for some time, whereas production management systems developed specifically for the process manufacturing sector are a comparatively recent development. Many of the major production management vendors, such as ASK, announced products during 1990, and it is likely that many more announcements will take place during 1991.

The fight for market share in this sector will be tough. As shown in Exhibit VI-10, the first priority of the application software product vendors is to establish their credibility as industry-knowledgeable organisations. Many of the potential vendors have core businesses which supply the discrete manufacturing sector, and this may be a handicap in terms of image.

Partnerships can be a key factor. Backing from one of the equipment vendors is obviously beneficial as can be a relationship with one of the major professional services vendors.

Many of the larger companies in the process manufacturing sector have European, if not global, coverage. The capability to sell and support on a pan-European basis is a prerequisite for targeting these users.

An additional factor is the high level of interest shown toward open systems and UNIX by companies in the process manufacturing sector. Vendors may have to develop UNIX-based versions of their products in the short to medium term.

EXHIBIT VI-10

Strategy: Application Software Product Vendors Process Manufacturing Sector, Western Europe

- Process manufacturing products are recent/imminent development
- Need to project credibility in coming battle for market share
- Partnerships vital
- Development of European coverage
- New technology

VII

User Issues

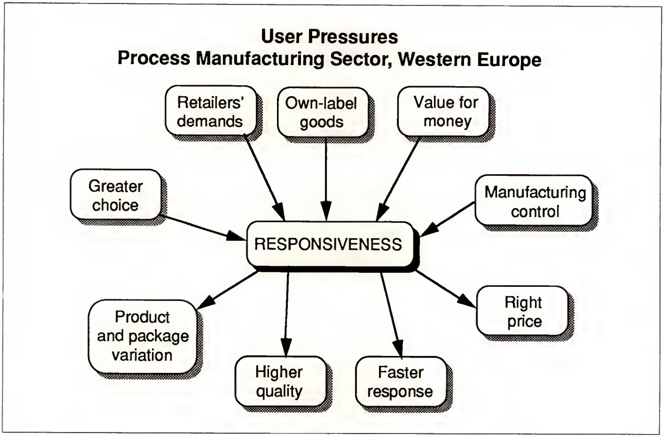
A

User Pressures

As Exhibit VII-1 shows, the main pressures on the process manufacturing sector are not cost pressures—though cost pressures brought about by an excess of supply over demand frequently operate in some of the low value-added subsectors such as basic chemicals. On the whole, companies in the chemicals and the food sectors are moving to high value-added products such as pharmaceuticals and ready-made meals. This is leading to a greater variety of products being produced and consequently the need to provide the right goods at the right time. This, in turn, necessitates a greater degree of manufacturing control by the manufacturer together with improved scheduling capability. For example, a manufacturer may be required to repackage an item for a retailer's in-store promotion. To do so successfully the manufacturer must schedule a shorter production run than usual and deliver on time.

Also, as manufacturers move to higher value-added products, quality becomes even more important. Hence lot traceability is necessary, and there is also a need to integrate quality within the production function which will lead to developments such as in-line quality monitoring.

EXHIBIT VII-1



B

Key Trends

Exhibit VII-2 shows the key trends identified by the user poll.

Traditionally production management systems used by the process manufacturing sector have been written in-house. There have been two main reasons for this. Firstly, conventional production management packages were seen as having been written to meet the needs of discrete manufacturing companies and so were not considered appropriate. Secondly, production management was previously seen as a comparatively simple task in the process manufacturing sector, since the product was highly standardized and was produced in large batch sizes; in some cases taking weeks or even years to produce.

This is now changing with the arrival of smaller batches, more variability, tighter delivery schedules, and the growing need for sophisticated lot traceability. This has resulted in a huge increase in demand for production management packages written specifically for the process manufacturing sector, along with a marked increase in the acceptability of standard application software packages.

There is also, as observed in the discrete manufacturing sector, a move to standardise the production management systems used across factories and subsidiaries. Major companies such as Unilever have up to 200 factories across Europe.

Once the production management system has been implemented, typically over the next two to three years, users intend to commence integrating these systems with their supervisory control and data acquisition (SCADA) systems to give full links to the process automation equipment. Given the high level of adoption of sophisticated process control equipment within the process manufacturing sector, and the comparative difficulty of automating shopfloor processes in the discrete manufacturing sector, the process manufacturing sector will probably achieve computer-integrated processing ahead of the discrete manufacturing sector.

EXHIBIT VII-2

Key User Trends
Process Manufacturing Sector, Western Europe

Trend	User Rating Profile				
	1	2	3	4	5
Increasing reliance on packages	-	-	-	2	3
Implementation of production management systems	-	-	-	1	4
Standardised systems across each factory	-	-	2	1	2
Adoption of relational databases	-	1	-	2	2
Move to full computer-integrated manufacturing systems	-	1	-	2	2
Integration of production management systems with SCADA systems	-	-	1	2	2

Scale of 1-5: 1 = Not At All Likely, 5 = Very Likely

Likelihood of adoption of trend.
Sample of five process manufacturing companies.

Companies in the process manufacturing sector are quite forward-looking in their use of technology. Exhibit VII-3 shows a high level of adoption of relational databases, and a commitment to move to distributed production management systems once these are available. This is accompanied by a significant trend to downsizing of equipment as mainframes become increasingly out of favour.

EXHIBIT VII-3

Major Technological Trends : User Perception
Process Manufacturing Sector, Western Europe

Trend	User Rating Profile				
	1	2	3	4	5
Standardised system across each factory	-	-	2	1	2
Adoption of relational databases	-	1	-	2	2
Downsizing of equipment	2	-	1	1	1
Adoption of distributed production management systems	2	-	-	1	1

Scale of 1-5: 1 = Not At All Likely, 5 = Very Likely

Likelihood of adoption of trend.

Sample of five process manufacturing companies.

As indicated in Exhibit VII-4, users in the process manufacturing sector are also strongly in favour of UNIX. One example of this is the Petrotechnical Open Software Corporation—a group of oil companies clearly committed to open systems and UNIX. However, there are also leading consumer goods companies, for example Unilever, that have declared policies of moving to open systems and UNIX for all their key applications.

EXHIBIT VII-4

User Adoption of UNIX
Process Manufacturing Sector, Western Europe

Area of Adoption	Likelihood of Users Adopting UNIX
Widespread use of UNIX	Medium
UNIX-based systems:	
- For production management	Medium
- For SCADA	Low

Sample of five process manufacturing companies

In contrast to the discrete manufacturing sector, where UNIX is expected to develop most strongly at the shopfloor (SFDCC) level, the process manufacturing sector views UNIX as an important technology at the production management level. UNIX is perceived as being less important at the supervisory control and data acquisition level on the basis that open systems are less meaningful where there is a requirement to link into a wide range of proprietary equipment supplied by the traditional process control manufacturers.

VIII

Logistics

A

Introduction

The term "logistics" is used to define the complete supply chain of a company from the purchase of raw materials to the receipt of finished goods by the customer. However, this total logistics operation is conventionally divided into two components:

- Manufacturing logistics, which is the management of raw materials within the manufacturing process itself, including stocks of finished goods held at the manufacturing site
- Distribution logistics, which is the management of finished goods in the distribution network of the manufacturer, up until the point they are accepted by a wholesaler, retailer or customer

This report is primarily concerned with distribution logistics and the interface between manufacturing and distribution systems.

B

Driving Forces

The business pressures which are driving process manufacturing companies to examine their logistics systems are listed in Exhibit VIII-1.

EXHIBIT VIII-1

Business Pressures: Logistics
Process Manufacturing Sector, Western Europe

- "1992"
- Customer service is paramount
- Cost pressure

Firstly, there is the impact of "1992". This has encouraged companies to re-evaluate their presence in each of the national markets of the Economic Community. It has led to a significant number of acquisitions by organisations such as BSN, Nestle, and Unilever as they seek to dominate their chosen market sectors on a pan-European basis. As these national markets become increasingly homogeneous in terms of regulations and buying characteristics, it encourages organisations such as Nestle to review the siting of their manufacturing and warehousing activities. In theory at least, the impact of "1992" should encourage manufacturers to rationalise their activities and concentrate both production and distribution at fewer, more efficient sites.

Customer service is especially important in the food and drinks sector. Here the manufacturers are facing considerable pressure from the major retail chains for "just-in-time" deliveries aimed at specific time windows. There are also pressures for greater product and packaging variability.

Finally, having taken steps to reduce their manufacturing costs in recent years, manufacturers are now finding that their distribution networks are a major source of cost.

The key challenges that process manufacturing companies face in controlling their logistics operations are shown in Exhibit VIII-2.

EXHIBIT VIII-2

Key Logistics Challenges
Process Manufacturing, Western Europe

- Forecasting/capturing demand
- Monitoring stock across the whole chain
- Optimising total logistic costs
- Generating performance indicators

One of the foremost problems is in gaining an accurate picture of demand which can be fed into the manufacturing process, and in identifying potential shortages early. Traditional forecasting models tend to smooth forecast demand and so it is important that any data relating to known orders is fed into the system as early as possible. There are two trends taking place in forecasting software at present:

- The use of knowledge-based systems as forecasting tools to allow most of the major factors which affect demand to be taken into account

- Forecasting across multiple factory sites and across the whole of the distribution network

There is also a need to monitor stock across the whole of the distribution network, and to source accordingly. At present, it is often difficult for one warehouse to identify stockholding of an item at other points in the distribution network.

Optimising total logistic costs is another issue. At present, there is a danger that the production management system and the distribution management system work in isolation, each seeking to minimize the costs within its own domain. However, this may not lead to the best level of efficiency across the whole of the supply chain.

Another significant challenge is the provision of information on the logistics operation to provide management with details of:

- Customer service levels achieved
- Actual costs of servicing each customer
- Stockholding of items across the chain
- Waste

C
Subsector Trends

1. Overall Demand

The overall levels of interest in logistics systems within the key subsectors of the process manufacturing sector are identified in Exhibit VIII-3.

EXHIBIT VIII-3

Level of Demand for Logistics Systems Process Manufacturing Sector, Western Europe

Subsector	Level of Demand
Food and drink	Medium
Pharmaceuticals	Low-Medium
Petrochemicals	Low

The food and drink subsector is the area of highest demand since it faces the greatest pressures from its key customers—the major retail chains. Overall, distribution logistics has received comparatively little attention from users in the past, but is now an area of increasing focus.

2. Food and Drink

There are three ways in which food and drink companies handle their distribution logistics:

- Outsourcing of entire distribution operation
- Direct plant shipments from factory
- Own-account distribution operations

Overall the trend is towards a reduction in the proportion of companies using own-account distribution operations. Historically, food and drink manufacturers sited their depots adjacent to the major centres of population to maintain proximity to the small retail outlets served. However, the food and drink sector is increasingly dominated—with the notable exception of Italy—by the major retail multiples who expect distribution to their own major distribution depots. This has removed the need for many manufacturers to maintain their secondary distribution networks. Indeed some companies in the food and drink sector are now evaluating the possibility of moving entirely to direct plant shipments.

However, other companies see their distribution network as a source of competitive advantage and are reviewing their logistics capability accordingly.

In many cases, the major retail multiples are forcing their suppliers to adopt EDI, and are moving to greater frequency of deliveries within clearly defined time slots.

3. Pharmaceuticals

At present, logistics is not an area of prime concern to pharmaceutical companies though this situation may change in the medium term. At present, many pharmaceutical companies are encouraged by national governments to set up manufacturing operations in a country as a by-product of the drug licensing process. This has led to an excess of capacity in many countries and has discouraged the establishment of cohesive, pan-European distribution networks by the pharmaceutical companies.

An additional factor is that the major expense in the pharmaceuticals sector is incurred in research and development, and licensing, rather than in the production process. Accordingly margins are comparatively high

and the cost of excessive stockholding is less critical than in other sectors which retain the product diversity of the pharmaceuticals sector but where production costs constitute a much higher proportion of the value added.

D

The Opportunities

The major opportunities for software and services vendors within the logistics function of process manufacturing companies are identified in Exhibit VIII-4.

EXHIBIT VIII-4

Major Opportunities in Logistics Process Manufacturing Sector, Western Europe

- Long-term planning system
- Warehouse management/automation
- Integration of major applications
- Provision of performance indicators

The first major opportunity area is in forecasting/scheduling software for both long-term planning—a month ahead—and short-term planning. The major impact on stockholding costs of finished goods lies in correctly predicting customer demand. A number of software products are now available which assist planning across multiple manufacturing and distribution sites, and some use knowledge-based software to take into account local factors influencing demand.

There are also opportunities for suppliers of warehouse management systems, and automated warehousing is being adopted for distribution centre to distribution centre operations. To improve warehouse operative efficiency, many systems now incorporate radio transmission of picking lists to hand-held units. Other systems enable multiple orders to be picked simultaneously to reduce operative movement around the warehouse and so increase efficiency.

In the past many information systems supporting logistics operations have existed as "islands by automation", such as:

- Forecasting and planning
- Warehousing
- Transport management
- Customer service management

There is now a need to integrate these and to measure the performance of the logistics operation as a whole.

E

Case Study

This case study illustrates some of the issues facing process manufacturing companies who retain their own-account distribution operations.

The company described is a food processing company serving three differing types of customer:

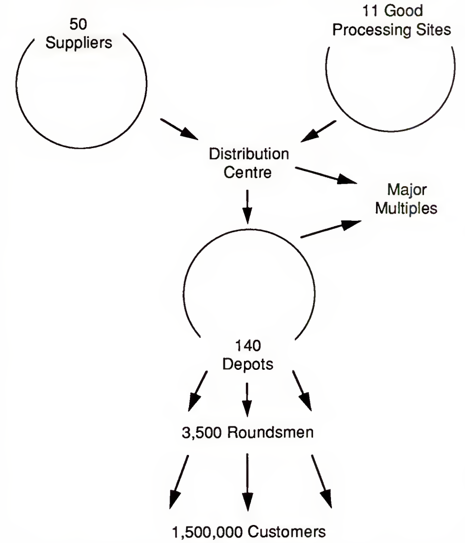
- Doorstep clients
- Corner shops
- Major retail multiples

The company had decided to take advantage of its strengths in doorstep and corner shop deliveries by offering this service to other suppliers for whom it would have been extremely costly to set up own-account operations to service these segments.

The resulting distribution network is shown in Exhibit VIII-5.

EXHIBIT VIII-5

The Distribution Network: Case Study



The pressures affecting the different types of business are quite varied. Firstly, the business pressures from the major multiples are listed in Exhibit VIII-6.

EXHIBIT VIII-6

Major Multiples: Issues

- Delivery locations often switched
- Very tight "time windows"
- "Drop drive" policy leads to retrospective invoice adjustments

The major multiples now insist on bulk deliveries within very tight "time windows", typically a 90-minute slot. Also these deliveries are often carried out on a "drop drive" basis, that is to unmanned locations. This means that orders and delivery notes cannot be reconciled on delivery and many adjustments to the invoice are subsequently received from the customer. Finally, although the multiples are prepared to commit to known volumes in advance, they have a tendency to switch locations. This poses particular problems for a regional producer of perishable goods, keen to avoid long hauls because of the impact on delivery costs.

The issues facing the distribution channel servicing the doorstep deliveries and corner shops are shown in Exhibit VIII-7.

EXHIBIT VIII-7

Doorstep Deliveries: Issues

- Price changes
- Leakage
- Customer care leads to alternative sourcing

High levels of customer care can disrupt the sales pattern since the roundsmen are likely to use alternative sources, such as supermarkets, if a particular item is unavailable. Also since the business is "cash-in-hand" and the timing of price changes is difficult to enforce with a manual system, there is extensive scope for leakage.

At the numerous small depots, the prevention of leakage is seen as a major problem as indicated in Exhibit VIII-8.

EXHIBIT VIII-8

Depots: Issues

- Wide stockholding/low volumes
- Poor stock ordering
- Updating of price lists
- Preventing leakage

Other critical issues include the comparatively high levels of stock held in the distribution chain. This is obviously a major problem with 140 small depots each holding stocks of around 2,500 items. The vagaries of the roundsmen's sourcing, together with the low skill level of the employees, also leads to a low standard of stock re-ordering. This situation can be further compounded by the low priority other suppliers attach to this operation. If any of these suppliers have difficulties in meeting orders for the major multiples, then supplies for the corner shops and doorstep deliveries would suffer.

This leaves the user with a requirement to introduce information systems to meet the objectives shown in Exhibit VIII-9.

EXHIBIT VIII-9

User Objectives: Case Study

- Reduce depot stock-holdings
- Provide accurate forecasts to suppliers
- Reduce wastage in chain

These objectives are being met by the introduction of a standalone stock control system into each depot, that also caters for invoicing from the depots to each corner shop. This helps to reduce leakage, especially since price changes could now be effectively implemented. At the end of each week, each depot is dialled from a central information system to collect the week's accounts and to update product and price lists.

The user believes that in time this system will assist in reducing depot stock levels significantly, and will enable better modelling of demand so that other suppliers can be provided with more accurate sales forecasts.

IX

The Opportunities

The principal opportunities for software and services in the Western European process manufacturing sector are shown in Exhibit IX-1. The major opportunity in the short term is undoubtedly the market for production management software. There has recently been considerable growth in this market with the result that the majority of the production management package vendors have launched, or are in the process of developing, products designed specifically for the process manufacturing sector.

EXHIBIT IX-1

Principal Opportunities
Process Manufacturing Sector,
Western Europe

- Production administration software
- Professional services/consultancy
- Integration of production management and process control systems
- Improved logistics systems
- Open systems

The next twelve months will be crucial in establishing the industry leaders. It will also be important to be on the right technology platform.

For IBM, the majority of sales will be of AS/400-based systems, though the RS/6000 may become a significant platform in the medium term. On other equipment platforms, UNIX will become important in the short-to-medium term.

Unlike the discrete manufacturing sector, where production management systems were initially installed in isolation with no thought given to their long-term integration with other applications, there is a strong awareness of the desirability of moving to computer-integrated processing in the process manufacturing sector. Accordingly, there is a greater commitment to open systems and extensive use of consultants for planning the organisations' overall information systems approach.

In the medium term, the integration of production management and process control systems will become a major opportunity. This development is already happening in some of the leading manufacturers. This form of integration provides considerable benefits to users, principally by providing up-to-date information on production status and by providing sophisticated facilities for lot traceability and quality assurance.

Another emerging opportunity is the need for more comprehensive and better integrated logistics support. Once the production function is under tight control, the next area for improvement in terms of increased customer responsiveness and greater efficiency is the distribution logistics function.

The principal opportunities within application software products, in addition to production management systems, are shown in Exhibit IX-2.

EXHIBIT IX-2

Principal Opportunities: Application Software Products, Process Manufacturing Sector Western Europe

- Production management
- Quality systems
- Process operations management
- Supervisory control and data acquisition
- Decision support

There is a strong need for in-line quality systems that measure the composition of both raw materials and final products, and that feed the results of these analyses, in real time, to both the control room or process operator and to the production management system.

To establish the link between production management systems and the manufacturing process, supervisory control and data acquisition (SCADA) systems and production supervision and control products—for example IBM Process Operations Management (POMS)—will also be in demand. The IBM POMS product is already reported to have had a good reception in Europe and the first installations are being implemented.

As more and more information becomes available from the shopfloor, there will be a demand for decision support systems to prevent management information overload.

The growth prospects for the key subsectors are summarized in Exhibit IX-3.

EXHIBIT IX-3

Key Industrial Sectors: Vendor Perspective
Process Manufacturing Sector, Western Europe

Sector	Growth Prospects
Pharmaceuticals	Very Good
Food and Drink	Good
Other Chemical, Oil and Gas, Paper and Pulp	Average

Pharmaceuticals was viewed as being the most promising subsector by all categories of vendor. Given the demographic trends within Western Europe, the demand for pharmaceutical products is expected to show appreciable growth. However, this same trend is causing concern with central governments worried by the trend in healthcare spending that may lead to cost reduction pressures on the pharmaceutical companies. This subsector has a tradition of high investment, particularly research and development expenditure.

The food and beverages subsector was seen as another area which is relatively immune to recessionary pressures. Overall, the food processing sector is moving towards a greater variety of high-quality products and needs to substantially improve the degree of manufacturing control achieved.

As shown in Exhibit IX-4, the main challenge for many vendors will be in establishing themselves within the process manufacturing sector. Traditionally this sector has developed most of its own production administration systems in-house, and is very suspicious of vendors perceived as traditional suppliers to the discrete manufacturing sector. Vendors will need to demonstrate both their business understanding of the sector and their systems capability. At the moment, there is a window of opportunity in the market for production management packages, and the next twelve months will be crucial in determining the market leaders.

EXHIBIT IX-4

Issues for Vendors
Process Manufacturing Sector, Western Europe

- Industry credibility
- Marketing new products and services
- High acceptability of UNIX
- European coverage
- Assembling product/service portfolio

There is a high level of acceptance of open systems and UNIX in the process manufacturing sector. This poses the question for vendors of when to move to UNIX-based rather than proprietary products.

Also, pan-European coverage is important for vendors targeting the leading process manufacturing companies. The latter typically have large numbers of plants spread throughout Europe.

At the present time, many equipment vendors and professional services vendors have still to assemble full product/service portfolios for the process manufacturing sector. It is important for vendors to be in a position to offer both sector-specific consultancy services and access for their clients to "best of breed" application software products.

Appendix: Definition of Terms

A

Overall Definitions and Analytical Framework

Information Services - Computer/telecommunications-related products and services that are oriented toward the development or use of information systems. Information services typically involve one or more of the following:

- Processing of specific applications using vendor-provided systems (called Processing Services)
- A combination of hardware, packaged software and associated support services which will meet a specific application processing need (called Turnkey Systems)
- Packaged software (called Software Products)
- People services that support users in developing and operating their own information systems (called Professional Services)
- Bundled combinations of products and services where the vendor assumes responsibility for the development of a custom solution to an information system problem (called Systems Integration)
- Services that provide operation and management of all or a significant part of a user's information systems functions under a long-term contract (called Systems Operations)
- Services associated with the delivery of information in electronic form-typically network-oriented services such as value-added networks, electronic mail and document interchange, on-line data bases, on-line news and data feeds, videotex, etc. (called **Network Services**)

In general, the market for information services does not involve providing equipment to users. The exception is where the equipment is bundled as part of an overall service offering such as a turnkey system, a systems operations contract, or a systems integration project.

The information services market also excludes pure data transport services (i.e., data or voice communications circuits). However, where information transport is associated with a network-based service (e.g., EDI or VAN services), or cannot be feasibly separated from other bundled services (e.g., some systems operations contracts), the transport costs are included as part of the services market.

The analytical framework of the **Information Services Industry** consists of the following interacting factors: overall and industry-specific business environment (trends, events and issues); technology environment; user information system requirements; size and structure of information services markets; vendors and their products, services and revenues; distribution channels, and competitive issues.

All **Information Services Market** forecasts are estimates of **User Expenditures** for information services. When questions arise about the proper place to count these expenditures, INPUT addresses them from the user's viewpoint: expenditures are categorized according to what users perceive they are buying.

By focusing on user expenditures, INPUT avoids two problems which are related to the distribution channels for various categories of services:

- Double counting, which can occur by estimating total vendor revenues when there is significant reselling within the industry (e.g., software sales to turnkey vendors for re-packaging and resale to end users)

- Missed counting, which can occur when sales to end users go through indirect channels such as mail order retailers

Market Sectors or markets, are groupings or categories of the users who purchase information services. There are three types of user markets:

- *Vertical Industry* markets, such as Banking, Transportation, Utilities, etc.

- *Functional Application* markets, such as Human Resources, Accounting, etc. These are also called "Cross-Industry" markets.

- *Generic* markets, which are neither industry- nor application-specific, such as the market for systems software.

Specific market sectors used by INPUT are defined in Section D, below.

Captive Information Services User Expenditures are expenditures for products and services provided by a vendor that is part of the same parent corporation as the user. These expenditures are not included in INPUT forecasts.

Non-captive Information Services User Expenditures are expenditures that go to vendors which have a different parent corporation than the user. It is these expenditures which constitute the information services market.

Delivery Modes are defined as specific products and services that satisfy a given user need. While *Market Sectors* specify *who* the buyer is, *Delivery Modes* specify *what* the user is buying.

Of the eight delivery modes defined by INPUT, five are considered primary products or services:

- *Processing Services*
- *Network Services*
- *Professional Services*
- *Applications Software Products*
- *Systems Software Products*

The remaining three delivery modes represent combinations of these products and services, bundled together with equipment, management and/or other services:

- *Turnkey Systems*
- *Systems Operations*
- *Systems Integration*

Section B describes the delivery modes and their structure in more detail.

Outsourcing is defined as the contracting of information systems (IS) functions to outside vendors. Outsourcing should be viewed as the opposite of *insourcing*: anything that IS management has considered feasible to do internally (e.g., data centre operations, applications development and maintenance, network management, training, etc.) is a potential candidate for outsourcing.

IS has always bought systems software, as it is infeasible for companies to develop it internally. However, all other delivery modes represent functions or products that IS management could choose to perform or develop in-house. Viewed this way, outsourcing is the result of a make-or-buy decision, and the outsourcing market covers any product or service where the vendor must compete against the client firm's own internal resources.

B

Industry Structure and Delivery Modes

1. Service Categories

The following Exhibit I-1 presents the structure of the information services industry. Several of the delivery modes can be grouped into higher-level **Service Categories**, based on the kind of problem the user needs to solve. These categories are:

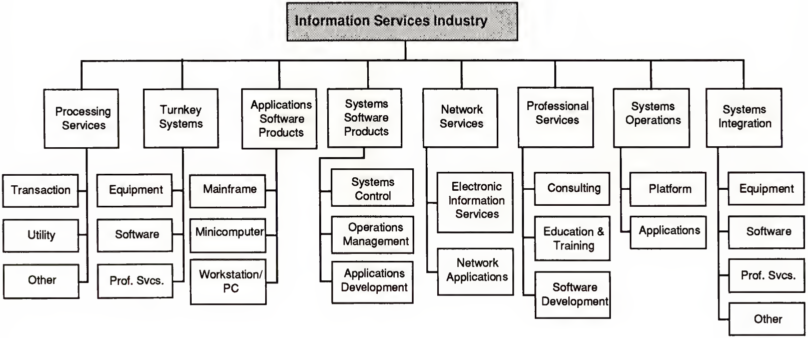
- **Business Application Solutions (BAS)** - prepackaged or standard solutions to common business applications. These applications can be either industry-specific (e.g., mortgage loan processing for a bank), cross-industry (e.g., payroll processing), or generic (e.g., utility time-sharing). In general, BAS services involve minimal customization by the vendor, and allow the user to handle a specific business application without having to develop or acquire a custom system or system resources. The following delivery modes are included under BAS:
  - Processing Services
  - Applications Software Products
  - Turnkey Systems
- **Systems Management Services (SMS)** - services which assist users in developing systems or operating/managing the information systems function. Two key elements of SMS are the customization of the service to each individual user and/or project, and the potential for the vendor to assume significant responsibility for management of at least a portion of the user's information systems function. The following delivery modes are included under SMS (research on these sectors is published in the Systems Management Programme):
  - Systems Operations
  - Systems Integration

Each of the remaining three delivery modes represents a separate service category:

- *Professional Services*
- *Network Services*
- *Systems Software Products*

EXHIBIT A-1

Information Services Industry Structure—1991



Source: INPUT

2. Software Products

There are many similarities between the applications and systems software delivery modes. Both involve user purchases of software packages for in-house computer systems. Included are both lease and purchase expenditures, as well as expenditures for work performed by the vendor to implement or maintain the package at the user's sites. Vendor-provided training or support in operation and use of the package, if bundled in the software pricing, is also included here.

Expenditures for work performed by organizations other than the package vendor are counted in the category of professional services. Fees for work related to education, consulting, and/or custom modification of software products are counted as professional services, provided such fees are charged separately from the price of the software product itself.

• Systems Software Products

Systems software products enable the computer/communications system to perform basic machine-oriented or user interface functions. These products include:

- *Systems Control Products* - Software programs that function during application program execution to manage computer system resources and control the execution of the application program. These products include operating systems, emulators, network control, library control, windowing, access control, and spoolers.

- *Operations Management Tools* - Software programs used by operations personnel to manage the computer system and/or network resources and personnel more effectively. Included are performance measurement, job accounting, computer operation scheduling, disk management utilities, and capacity management.

- *Applications Development Tools* - Software programs used to prepare applications for execution by assisting in designing, programming, testing, and related functions. Included are traditional programming languages, 4GLs, data dictionaries, data base management systems, report writers, project control systems, CASE systems and other development productivity aids. Also included are system utilities (e.g., sorts) which are directly invoked by an applications program.

• Application Software Products

- *Industry-Specific Application Software Products* - Software products that perform functions related to solving business or organizational needs unique to a specific vertical market and sold to that market

only. Examples include demand deposit accounting, MRPII, medical recordkeeping, automobile dealer parts inventory, etc.

- *Cross-Industry Application Software Products* - Software products that perform a specific function that is applicable to a wide range of industry sectors. Applications include payroll and human resource systems, accounting systems, word processing and graphics systems, spreadsheets, etc.

3. Turnkey Systems

A turnkey system is an integration of equipment (CPU, peripherals, etc.), systems software, and packaged or custom application software into a single system developed to meet a specific set of user requirements. Value added by the turnkey system vendor is primarily in the software and support services provided. Most CAD/CAM systems and many small business systems are turnkey systems. Turnkey systems utilize standard computers and do not include specialized hardware such as word processors, cash registers, process control systems, or embedded computer systems for military applications.

Hardware vendors that combine software with their own general-purpose hardware are not classified by INPUT as turnkey vendors. Their software revenues are included the appropriate software category.

Most turnkey systems are sold through channels known as value-added resellers.

- *Value-Added Reseller (VAR):* A VAR adds value to computer hardware and/or software and then resells it to an end user. The major value added is usually application software for a vertical or cross-industry market, but also includes many of the other components of a turnkey systems solution, such as professional services.

Turnkey systems are divided into two categories.

- *Industry-Specific Systems* - systems that serve a specific function for a given industry sector, such as automobile dealer parts inventory, medical recordkeeping, or discrete manufacturing control systems.

- *Cross-Industry Systems* - systems that provide a specific function that is applicable to a wide range of industry sectors, such as financial planning systems, payroll systems, or personnel management systems.

4. Processing Services

This category includes transaction processing, utility processing, and other processing services.

- *Transaction Processing:* - Client uses vendor-provided information systems-including hardware, software and/or data networks-at vendor site or customer site, to process transactions and update client data bases. Transactions may be entered in one of four modes:
  - *Interactive* - Characterized by the interaction of the user with the system for data entry, transaction processing, problem solving and report preparation: the user is on-line to the programs/files stored on the vendor's system.
  - *Remote Batch* - Where the user transmits batches of transaction data to the vendor's system, allowing the vendor to schedule job execution according to overall client priorities and resource requirements.
  - *Distributed Services* - Where users maintain portions of an application data base and enter or process some transaction data at their own site, while also being connected through communications networks to the vendor's central systems for processing other parts of the application.
  - *Carry-in Batch* - Where users physically deliver work to a processing services vendor.
- *Utility Processing*: Vendor provides basic software tools (language compilers, assemblers, DBMSs, graphics packages, mathematical models, scientific library routines, etc.), generic applications programs and or data bases, enabling clients to develop their own programs or process data on vendor's system.
- *Other Processing Services*: Vendor provides services-usually at vendor site-such as scanning and other data entry services, laser printing, computer output microfilm (COM), CD preparation and other data output services, backup and disaster recovery, etc.

5. Systems Operations

Systems operations involves the operation and management of all or a significant part of the user's information systems functions under a long-term contract. These services can be provided in either of two distinct submodes:

- *Professional Services:* The vendor provides personnel to operate client-supplied equipment. Prior to 1990, this was a submode of the Professional Services delivery mode.
- *Processing Services:* The vendor provides personnel, equipment and (optionally) facilities. Prior to 1990, this was a submode of the Processing Services delivery mode.

Systems operations vendors now provide a wide variety of services in support of existing information systems. The vendor can plan, control, provide, operate, maintain and manage any or all components of the user's information systems (equipment, networks, systems and/or application software), either at the client's site or the vendor's site. Systems operations can also be referred to as "resource management" or "facilities management."

There are two general levels of systems operations:

- *Platform/network operations* - where the vendor operates the computer system and/or network without taking responsibility for the applications
- *Application operations* - where the vendor takes responsibility for the complete system, including equipment, associated telecommunications networks, and applications software

Note: Systems Operations is a relatively new delivery mode introduced in the 1990 Systems Management Programme - Europe. It was created by taking the Systems Operations submode out of both Processing Services and Professional Services. No other change has been made to the delivery mode definitions, and the total forecast expenditures for these three delivery modes are identical to the total forecast expenditures of the two original modes before the breakout of Systems Operations.

6. Systems Integration (SI)

Systems integration is a business offering that provides a complete solution to an information system, networking or automation requirement through the custom selection and implementation of a variety of information system products and services. A systems integrator is responsible for the overall management of a systems integration contract and is the single point of contact and responsibility to the buyer for the delivery of the specified system function, on schedule and at the contracted price.

To be included in the information services market, systems integration projects must involve some application processing component. In addition, the majority of cost must be associated with information systems products and/or services. The SI sector is fully analysed and reported in INPUT's Systems Management Programme.

The systems integrator will perform, or manage others who perform, most or all of the following functions:

- Program management, including subcontractor management
- Needs analysis

- Specification development
- Conceptual and detailed systems design and architecture
- System component selection, modification, integration and customization
- Custom software design and development
- Custom hardware design and development
- Systems implementation, including testing, conversion and post-implementation evaluation and tuning
- Life cycle support, including
  - System documentation and user training
  - Systems operations during development
  - Systems maintenance
- Financing

7. Professional Services

This category includes consulting, education and training, and software development.

- *Consulting:* Services include management consulting (related to information systems), information systems consulting, feasibility analysis and cost-effectiveness studies, and project management assistance. Services may be related to any aspect of information systems, including equipment, software, networks and systems operations.
- *Education and Training:* Products and services related to information systems and services for the professional and end user, including computer-aided instruction, computer-based education, and vendor instruction of user personnel in operations, design, programming, and documentation.
- *Software Development:* Services include user requirements definition, systems design, contract programming, documentation and implementation of software performed on a custom basis. Conversion and maintenance services are also included.

8. Network Services

Network services typically include a wide variety of network-based functions and operations. Their common thread is that most of these functions could not be performed without network involvement. Network services is divided into two major segments: *Electronic Information Services,* which involve selling information to the user, and *Network Applications,* which involve providing some form of enhanced transport service in support of a user's information processing needs.

- *Electronic Information Services*

Electronic information services are data bases that provide specific information via terminal- or computer-based inquiry, including items such as stock prices, legal precedents, economic indicators, periodical literature, medical diagnosis, airline schedules, automobile valuations, etc. The terminals used may be computers themselves, such as communications servers or personal computers. Users typically inquire into and extract information from the data bases. Although users may load extracted data into their own computer systems, the electronic information vendor provides no data processing or manipulation capability and the users cannot update the vendor's data bases.

The two kinds of electronic information services are:

- *On-line Data Bases* - Structured, primarily numerical data on economic and demographic trends, financial instruments, companies, products, materials, etc.
- *News Services* - Unstructured, primarily textual information on people, companies, events, etc.

While electronic information services have traditionally been delivered via networks, there is a growing trend toward the use of CD ROM optical disks to support or supplant on-line services, and these optical disk-based systems are included in the definition of this delivery mode.

- *Network Applications*
  - *Value-Added Network Services (VAN Services)* - VAN services are enhanced transport services which involve adding such functions as automatic error detection and correction, protocol conversion, and store-and-forward message switching to the provision of basic network circuits.

While VAN services were originally provided only by specialized VAN carriers (Tymnet, Telenet, etc.), today these services are also offered by traditional common carriers (AT&T, Sprint, etc.). Meanwhile, the VAN

carriers have also branched into the traditional common carriers' markets and are offering unenhanced basic network circuits as well.

INPUT's market definition covers VAN services only, but includes the VAN revenues of all types of carriers.

- *Electronic Data Interchange (EDI)* - Application-to-application exchange of standardized business documents between trade partners or facilitators. This exchange is commonly performed using VAN services. Specialized translation software is typically employed to convert data from organizations' internal file formats to EDI interchange standards; this software may be provided as part of the VAN service, or may be resident on the organization's own computers.
- *Electronic Information Exchange (EIE)* - Also known as Electronic Mail (E-Mail), EIE involves the transmission of messages across an electronic network managed by a services vendor, including facsimile transmission (FAX), voice mail, voice messaging, and access to Telex, TWX, and other messaging services. This also includes bulletin board services.

- *Other Network Services* - This segment contains videotex and pure network management services. Videotex is actually more a delivery mode than an application. Its prime focus is on the individual as a consumer or in business. These services provide interactive access to data bases and offer the inquirer the capability to send as well as receive information for such purposes as home shopping, home banking, travel reservations, and more.

Network management services included here must involve the vendor's network and network management systems as well as people. People-only services, or services that involve the management of networks as part of the broader task of managing a user's information processing functions are included in Systems Operations.

Network Services research is fully reported in INPUT's Network Services Programme.

C

Vendor Revenue and User Expenditure Conversion

The size of the information services market may be viewed from two perspectives: vendor (producer) revenues, and user expenditures. While the primary data for INPUT's research is vendor interviews, INPUT defines and forecasts the information services market in terms of end-user expenditures. End-user expenditures reflect the markup in producer sales when a product such as software is delivered through indirect distribution channels, such as original equipment manufacturers (OEMs), retailers and distributors. The focus on end-user expenditure also eliminates the double counting of revenues which would occur if sales were tabulated for both producer (e.g., Lotus) and distributor (e.g., BusinessLand).

For most delivery modes, vendor revenues and user expenditures are fairly close. However, there are some significant areas of difference. Many microcomputer software products, for example, are marketed through indirect distribution channels. To capture the valued added through these indirect distribution channels, adjustment factors which incorporate industry discount ratios are used to convert estimated information services vendor revenues to end-user expenditures.

For some delivery modes, including software products, systems integration and turnkey systems, there is a significant volume of intra-industry sales. For example, systems integrators purchase software and subcontract the services of other professional services vendors. Turnkey vendors incorporate purchased software into the systems which they sell to end users.

D

Sector Definitions and Delivery Mode Reporting

1. Industry Sector Definitions (Vertical Markets)

INPUT has structured the information services market into 16 generic industry sectors, such as process manufacturing, insurance, transportation, etc. The definitions of these sectors are based on the 1987 revision of the Standard Industrial Classification (SIC) Code system. The specific industries (and their SIC Codes) included under these generic industry sectors are detailed in the following tables.

Sector:	Discrete Manufacturing
SIC Code	Market subsector description
23XX	Apparel and other finished products
25XX	Furniture and fixtures
27XX	Printing, publishing and allied industries
31XX	Leather goods
34XX	Fabricated metal products except machines
35XX	Industrial and commercial machines and computer
36XX	Electronic and electrical equipment except computer
37XX	Transportation equipment
38XX	Instruments; photo/med/opt goods; watches/clocks
39XX	Miscellaneous

Sector:	Process Manufacturing
10XX	Metal mining
12XX	Coal mining
13XX	Oil and gas extraction
14XX	Mining non-metalic minerals
20XX	Food products
21XX	Tobacco products
22XX	Textile mill products
24XX	Lumber and wood products except furniture

26XX	Paper and allied products
28XX	Chemicals and allied products
29XX	Petroleum refined and related industries
30XX	Rubber and miscellaneous plastic products
32XX	Stone, clay, glass and concrete products
33XX	Primary metal industries

Sector:	Distribution
SIC Code	Market subsector description
50XX	Wholesale trade - durable goods
51XX	Wholesale trade - nondurable goods
52XX	Retail - building materials
53XX	Retail - general merchandise stores
54XX	Retail - food stores
55XX	Retail - automotive dealers, gas stations
56XX	Retail - apparel and accessory stores
57XX	Retail - home furniture, furnishings and accessories
58XX	Retail - eating and drinking places
59XX	Retail - miscellaneous

Sector:	Banking and Finance
60XX	Depository institutions
61XX	Nondepository institutions
62XX	Security and commodity brokers, dealers and exchanges
67XX	Holding and other investment offices

Sector:	Insurance
63XX	Insurance carriers
64XX	Insurance agents,brokers and services

SIC Code	Other Sectors
	Miscellaneous Industries:
01XX	Agricultural production - crops
02XX	Agricultural production - livestock
07XX	Agricultural services
08XX	Forestry
09XX	Fishing, hunting and trapping
15XX	Building construction - general contractors
16XX	Heavy construction - contractors
17XX	Construction - special trade contractors
	Transportation Services:
40XX	Rail transport
41XX	Public transit/transport
42XX	Motor freight transport/warehousing
43XX	Postal services
44XX	Water transportation
45XX	Air transportation except airline reservation

46XX	Pipelines except natural gas
47XX	Transportation services except travel agents
	Utilities:
49XX	Electric, gas and sanitary services
48XX	Telecommunications
80XX	Health services
82XX	Educational services
	Business and Technical Services:
65XX	Real estate
73XX	Business services
81XX	Legal services
87XX	Engineering, accounting, research, management services
89XX	Miscellaneous services
9XXX	Government
	Personal/Consumer Services:
4512X	Airline reservation services
472X	Travel agents
70XX	Hotels, rooming houses, camps and lodgings
72XX	Personal services
7389X	Hotel reservation services
75XX	Automotive repair services and parking
76XX	Miscellaneous repair services
78XX	Motion pictures
79XX	Amusement and recreation services
83XX	Social services
84XX	Museums, art galleries and botanical gardens
86XX	Membership organisations
88XX	Private households

2. Cross-Industry Sector Definitions (Horizontal Markets)

In addition to these vertical industry sectors, INPUT has also identified seven cross-industry or horizontal market sectors. These sectors or markets involve multi-industry applications such as human resource systems, accounting systems, etc. In order to be included in an industry sector, the service or product delivered must be specific to that sector only. If a service or product is used in more than one industry sector, it is counted as cross-industry. The seven cross-industry markets are:

- *Human Resource Systems*
- *Education and Training*
- *Office Systems*
- *Accounting Systems*

- *Engineering and Scientific Applications*
- *Planning and Analysis Systems*
- *Other Applications (including telemarketing, sales management and electronic publishing)*

B

Appendix: Related INPUT Reports

- *The Challenge of the Single European Market—1992 and Beyond*
- *The Western European Market for Computer Software and Services, 1990-1995*
- *European Software and Services Market, 1991-1996—Insurance Sector*
- *European Software and Services Market, 1991-1996—Banking and Finance Sector*
- *European Software and Services Market, 1991-1996—Distribution Sector*
- *European Software and Services Market, 1991-1996—Discrete Manufacturing Sector*

C

Appendix: Exchange Rates

1. European Exchange Rates

The following table, Exhibit C-1, shows the standard exchange rates used throughout the 1991 programme to consolidate country market data for overall Western European forecasts and vendor market shares.

EXHIBIT C-1

U.S. Dollar and ECU Exchange Rates, 1991

Country	Currency	U.S. Dollar Exchange Rate	ECU Exchange Rate
France	FF	5.65	7.74
Germany	DM	1.68	2.30
United Kingdom	£	0.515	0.704
Italy	Lira	1,233.0	1,689.0
Sweden	Sek	5.61	7.69
Denmark	DK	6.39	8.75
Norway	NK	6.49	8.89
Finland	FM	3.96	5.43
Netherlands	Dfl	1.69	2.32
Belgium	BF	34.60	47.40
Switzerland	SF	1.27	1.74
Austria	Sch	11.80	16.17
Spain	Ptas	95.0	130.12
U.S.A	$	1	1.37

Source: Barclays Bank (Q4 1990)

Exhibit C-2 shows the standard exchange rates used throughout the 1990 programme to consolidate country market data for overall Western European forecasts and vendor market shares.

EXHIBIT C-2

U.S. Dollar and ECU Exchange Rates 1990

Country	Currency	U.S. Dollar Exchange Rate	ECU Exchange Rate
France	FF	6.17	6.87
Germany	DM	1.81	2.05
United Kingdom	£	0.631	0.74
Italy	Lira	1,336	1,502
Sweden	Sek	6.39	7.41
Denmark	DK	7.05	7.8
Norway	NK	6.85	7.94
Finland	FM	4.21	4.84
Netherlands	Dfl	2.05	2.3
Belgium	BF	38.06	42.29
Switzerland	SF	1.61	1.8
Austria	Sch	12.77	14.39
Spain	Ptas	115.8	129.7
U.S.A	$	1	1.20

Source: Barclays Bank (Q4 1990)

2. European Inflation Rates

Exhibit C-3 shows the average five-year inflation assumptions for each reported country and the changes from those used in reports produced in the previous year. All INPUT forecasts include the effects of inflation as well as natural market growth rates. For consistency, the same inflation rates are used throughout all the different market sector research and analysis during a calendar year, unless specified otherwise.

EXHIBIT C-3

Inflation Assumptions 1990 and 1991

Country	Assumption 1990-1995	Assumption 1991-1996	Change
France	4.5	3.0	-1.5
Germany	4	2.7	-1.3
United Kingdom	7	4.8	-2.2
Italy	7	4.4	-2.6
Sweden	7	6.3	-0.7
Denmark	5	2.7	-2.3
Norway	5	4.9	-0.1
Finland	6	5.0	-1.0
Netherlands	3	2.4	-0.6
Belgium	4	3.3	-0.7
Switzerland	5	3.3	-1.7
Austria	4	2.6	-1.3
Spain	6.5	4.7	-1.8
Rest of Europe	10	7.7	-2.5
European Average	5.5	4.0	-1.5

Sources: OECD 1991 Forecast
IMF 1989

D

Appendix: Market Forecasts

EXHIBIT D-1

France User Expenditure (FF Millions)

Delivery Mode	1991	1992	1993	1994	1995	1996	CAGR (Percent)
Processing Services	480	490	510	530	550	585	4
Network Services	510	600	720	870	1030	1220	19
Application Software Products	790	990	1230	1500	1820	2140	22
Professional Services	2200	2570	3050	3700	4400	5250	19
Systems Integration	145	175	210	250	300	360	20
Turnkey Systems	1250	1500	1850	2160	2500	2860	18
Systems Operations	700	825	980	1180	1450	1740	20
Total	6080	7150	8550	10190	12050	14155	18

EXHIBIT D-2

Germany User Expenditure (DM Millions)

Delivery Mode	1994	1992	1993	1994	1995	1996	CAGR (Percent)
Processing Services	115	120	125	130	130	133	3
Network Services	100	125	160	200	250	310	25
Application Software Products	270	340	425	530	650	790	24
Professional Services	485	570	680	820	990	1200	20
Systems Integration	95	115	140	165	200	235	20
Turnkey Systems	460	570	700	850	1020	1200	21
Systems Operations	33	40	48	58	70	82	20
Total	1560	1880	2280	2750	3310	3950	20

EXHIBIT D-3

U.K. User Expenditure (£ Millions)

Delivery Mode	1991	1992	1993	1994	1995	1996	CAGR (Percent)
Processing Services	30	32	33	34	35	37	4
Network Services	40	45	53	62	73	88	17
Application Software Products	70	87	110	135	162	190	22
Professional Services	115	135	162	188	220	263	18
Systems Integration	32	38	47	58	70	83	21
Turnkey Systems	110	135	162	190	215	240	17
Systems Operations	60	75	92	112	135	162	22
Total	457	548	660	780	910	1060	18

EXHIBIT D-4

Italy User Expenditure (Lira Billions)

Delivery Mode	1991	1992	1993	1994	1995	1996	CAGR (Percent)
Processing Services	43	45	47	49	51	53	4
Network Services	40	46	53	63	75	92	18
Application Software Products	105	128	158	190	225	260	20
Professional Services	200	230	265	300	350	420	16
Systems Integration	9	11	13	15	18	20	18
Turnkey Systems	120	142	170	195	222	252	16
Systems Operations	25	28	32	37	45	55	17
Total	540	630	740	850	990	1150	16

EXHIBIT D-5

France User Expenditure ($ Millions)

Delivery Mode	1994	1992	1993	1994	1995	1996	CAGR (Percent)
Processing Services	85	87	90	95	97	105	14
Network Services	90	105	125	155	180	215	19
Application Software Products	140	175	220	265	320	380	22
Professional Services	390	455	540	655	780	930	19
Systems Integration	25	30	37	45	53	65	20
Turnkey Systems	220	265	325	380	440	510	18
Systems Operations	125	145	175	210	260	310	20
Total	1080	1270	1500	1800	2130	2500	18

EXHIBIT D-6

Germany User Expenditure ($ Millions)

Delivery Mode	1994	1992	1993	1994	1995	1996	CAGR (Percent)
Processing Services	68	71	74	77	77	80	3
Network Services	60	75	95	120	150	185	25
Application Software Products	160	200	250	320	390	470	24
Professional Services	290	340	400	490	590	710	20
Systems Integration	57	70	85	100	120	140	20
Turnkey Systems	275	340	420	500	600	710	21
Systems Operations	20	25	30	35	42	50	20
Total	930	1120	1350	1650	1970	2350	20

EXHIBIT D-7

United Kingdom User Expenditure ($ Millions)

Delivery Mode	1991	1992	1993	1994	1995	1996	CAGR (Percent)
Processing Services	58	62	64	66	68	72	4
Network Services	78	87	100	120	140	170	17
Application Software Products	135	170	215	260	315	370	22
Professional Services	225	260	315	365	430	510	18
Systems Integration	62	75	90	115	135	160	21
Turnkey Systems	215	260	315	370	415	470	17
Systems Operations	115	145	180	220	260	315	22
Total	890	1100	1280	1500	1770	2070	18

EXHIBIT D-8

Italy User Expenditure ($ Millions)

Delivery Mode	1991	1992	1993	1994	1995	1996	CAGR (Percent)
Processing Services	35	36	38	40	41	43	4
Network Services	32	37	43	50	60	75	18
Application Software Products	85	105	128	155	180	210	20
Professional Services	162	190	215	245	285	340	16
Systems Integration	7	9	11	12	15	16	18
Turnkey Systems	95	115	140	160	180	205	16
Systems Operations	20	23	26	30	35	45	17
Total	440	510	600	690	800	930	16

EXHIBIT D-9

Rest of Europe User Expenditure ($ Millions)

Delivery Mode	1991	1992	1993	1994	1995	1996	CAGR (Percent)
Processing Services	83	85	90	93	97	102	4
Network Services	88	100	120	140	170	200	18
Application Software Products	180	220	270	320	380	455	20
Professional Services	375	450	530	510	730	860	18
Systems Integration	17	20	25	32	40	45	22
Turnkey Systems	270	320	380	440	510	590	17
Systems Operations	45	53	65	75	90	105	18
Total	1060	1250	1480	1720	2000	2350	17

E

Appendix: Forecast Reconciliation 1990-1991

Exhibit E-1 shows the changes made in this year's forecast in comparison to that of the previous year.

The change in the growth rates in the latest forecast largely reflects the differing inflation assumptions made in the two forecasts. The latest assumptions are on average two percent per annum lower across the major European economies.

Exhibit E-2 shows the modifications to the growth rates by delivery mode for each of the major countries. Sales of application software products and systems integration are forecast to remain buoyant, driven by the new products entering the market, while professional services growth is forecast to be slightly lower than previously forecast.

Overall it is forecast that the process manufacturing sector will remain a comparatively buoyant sector for software and servcies vendors during a period of difficult economic conditions in Europe.

EXHIBIT E-1

Reconciliation of Market Forecast
Process Manufacturing Sector, Western Europe

Country	1990 Market			1995 Market			1990 1995 CAGR Forecast in 1990 (Percent)	1991 1996 CAGR Forecast in 1991 (Percent)
	1990 Report	1991 Report	Variance (Percent)	1990 Report	1991 Report	Variance (Percent)		
France (FFm)	5040	5040	-	12,550	12,050	(4)	20	18
Germany (DMm)	1277	1277	-	3365	3310	(2)	21	20
U.K. (£m)	379	379	-	925	910	(2)	20	18
Italy (Lira Bn)	454	454	-	1094	986	(10)	19	16

EXHIBIT E-2

Reconciliation of Growth Rates by Delivery Mode
Process Manufacturing Sector, Western Europe

Delivery Mode	France			Germany			U.K.			Italy		
	1990* Report	1991† Report	Variance	1990* Report	1991† Report	Variance	1990* Report	1991† Report	Variance	1990* Report	1991† Report	Variance
Processing Services	4	4	-	3	3	-	4	4	-	4	4	-
Network Services	22	19	(3)	28	25	(3)	20	17	(3)	21	18	(3)
Application Software Products	22	22	-	25	24	(1)	23	22	(1)	21	20	(1)
Professional Services	21	19	(2)	22	20	(2)	20	18	(2)	21	16	(5)
Systems Integration	20	20	-	20	20	-	21	21	-	18	17	(1)
Turnkey Systems	19	18	(1)	21	21	-	17	17	-	19	16	(3)
Systems Operations	23	20	(3)	23	20	(3)	25	22	(3)	20	17	(3)
Overall	20	18	(2)	21	20	(1)	20	18	(2)	19	16	(3)

Notes: * 1990 - 1995 CAGR

†1991 - 1996 CAGR

F

Appendix: Vendor Questionnaire—Logistics

1. What are the key pressures faced by users in their logistics operations?

2. How are these pressures affecting their IS requirements?

3. What types of logistics software and services are users seeking?

4. What subsectors of the process manufacturing sector are showing the greatest levels of demand?

5. What benefits are users finding can be achieved in practice from improved IS systems?

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Thank you for your assistance